SONY®

Training Manual

Direct View Television

BA-5 Chassis

Models: KV-13FM12, KV-13FM13, KV-13FM14, KV-20FV12, KV-20FS12, KV-24FV12, KV-27FS12, KV-27FS16, KV-27FV16, KV-32FS12, KV-32FS16



KV-20FS12

Circuit Description and Troubleshooting

Course: CTV-27

Circuit Description and Troubleshooting:

Models:

KV-13FM12	KV-27FS12
KV-13FM13	KV-27FS16
KV-13FM14	KV-27FV16
KV-20FV12	KV-32FS12
KV-20FS12	KV-32FS16
KV-24FV12	

Prepared by: National Training Department
Sony Service Company
A Division of Sony Electronics Inc.

Course presented by ____________________________________

Date ____

Student Name ____

Table of Contents

Features

Overview

The following section discusses the various features for BA-5 models. These features will be separated into four categories: Audio, Video, Convenience and Input/Output. The BA-5 chassis covers the following models:

KV-13FM12	**KV-27FS12**
KV-13FM13	**KV-27FS16**
KV-13FM14	**KV-27FV16**
KV-20FS12	**KV-32FS12**
KV-20FV12	**KV-32FS16**
KV-24FV12	

The 13" models are identical except they are different colors. The FM12 is gray, FM13 is white and the FM14 is blue. These models will have the same features as the FM12 listed in the following section.

Audio Features

- All models contain the **Auto Mute** function. Auto Mute mutes the audio when no signal is received. This prevents loud static from being heard when no station is received. The display will also indicate No Signal in the lower left-hand corner.
- All models are **Stereo** with **Auto SAP** except for the 13" inch models. The 13" inch models are mono and contain only one speaker.
- All 24" and under manuals contain a headphone jack.
- All "V" models contain the **Steady Sound Auto Volume**, **BBE** enhancement and **Dynamic Acoustic Chamber (DAC)** features.

The following table shows the type of surround sound and audio output power:

	Surround	**Power Output**
KV-13FM12	N/A	3W
KV-20FS12	N/A	3W x 2
KV-20FV12	Matrix	5W x 2
KV-24FV12	SRS 3D	10W x 2
KV-27FS12	Matrix	5W x 2
KV-27FS16	Matrix	5W x 2
KV-27FV16	SRS 3D	15W x 2
KV-32FS12	Matrix	5W x 2
KV-32FS16	Matrix	5W x 2

Video Features

All models contain the following video features

FD Trinitron WEGA TV	**Auto Pedestal Clamp**
Dynamic Picture Processor	**Vertical Aperture Compensation**
Auto White Balance	

- All 20" and above models use **Velocity Modulation** to enhance the picture.
- All 27" and above use **Dynamic Focus**, **Magnetic Quadra-pole** and **Trinitone Color Temperature Adjustment** circuits.
- The KV-27FV16 contains a 3D Digital Comb filter to enhance the picture quality. It also has **Enhanced 16:9 Mode.**

• Convenience Features

All the BA-5 models contain the following Convenience features:

Speed Surf Tuning	**Clock Timer (2 events)**
Advanced On-screen Menu	**Sleep Timer (15/30/45/60/90)**
Channel Label	**V Chip Parental Control**
Video Label	**XDS/Closed Captioning**
Multi Language Display	**Auto Channel Programming**
Favorite Channel or	**Customer Tilt Control**
Favorite Preview	

- The KV-20FV12, KV-24FV12 and all 27" and above models have the **Preset Program Palette** feature.
- The KV-27FV16, KV-27FS16 and the KV-32FS16 contain 2 tuner PIP. This includes the **Freeze Memo** feature.

Input/Output

	S Video *	Y/Pb/Pr	Composite *	Fix/Var. Out
KV-13FM12	-/-	N/A	-/-	N/A
KV-20FS12	-/-	N/A	1/1	N/A
KV-20FV12	1/-	N/A	1/1	Yes
KV-24FV12	1/-	N/A	1/1	Yes
KV-27FS12	1/-	1	2/1	Yes
KV-27FS16	1/-	1	2/1	Yes
KV-27FV16	1/1	1	2/1	Yes
KV-32FS12	1/-	1	2/1	Yes
KV-32FS16	1/-	1	2/1	Yes

*** Rear/Front**

- The KV-27FV16 contains a Monitor Out jack.

Feature Glossary

Auto Mute – Mutes the audio output when the tuner receives no signal. This keeps the loud volume from occurring due to static.

Auto SAP – If activated, Auto SAP automatically switches to the SAP audio if SAP audio is present.

BBE Audio Enhancement – Shifts the phase of the audio signal to improve TV sound.

Dynamic Acoustic Chamber (DAC) – A speaker enclosure that uses the cabinet to improve sound quality.

SRS 3D – A digital signal-processing algorithm that simulates surround sound using only two speakers.

Dynamic Focus – Automatically adjusts the focus to improve focus on certain parts of the screen.

Magnetic Quadra-pole – Controls the electron beam magnetically to enhance picture resolution.

Trinitone Color Temperature Adjustment – Enables the user to adjust the color temperature to warmer or cooler to match the program.

Enhanced 16:9 Mode - This mode uses vertical compression to enhance "anamorphic" widescreen video from DVDs.

Advanced On Screen Menu – A new colorful On-Screen Menu that is more intuitive and easier to use.

Preset Program Palette – Picture types that are preset. These include Vivid, Standard, Sports and Movie.

Freeze Memo – Allows you to save an item on the screen in the PIP window while the main picture continues in real time.

Y/Pb/Pr - Delivers optimum picture quality by supplying separate connections for luminance (Y), blue color difference (P B) and red color difference (P R). Ideal for DVD players and Digital Television (DTV) set top receiver/decoders.

Speed Surf Tuning – Allows faster channel scanning when you hold down the Channel Up/Down buttons.

Board Descriptions

24” and Under

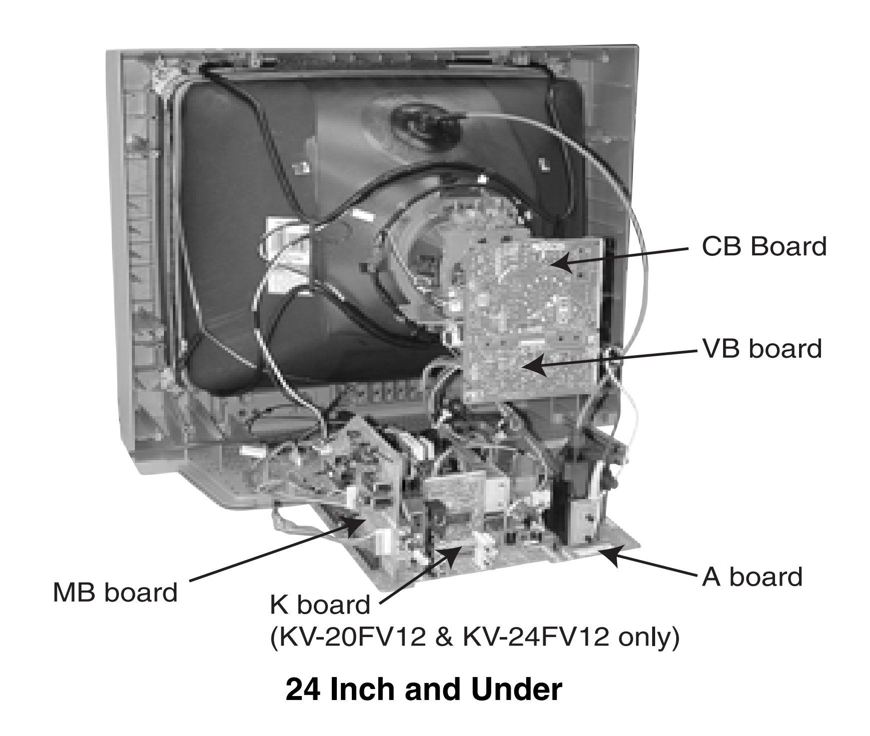
Board Name	Description
A	Power Supply, A/V Inputs, DGC, Tuner, Pincushion, H Deflection, V Deflection, Audio Amp, Switches, LEDs
K	Audio Processor and SRS Processor
CB	CRT Drive and N/S Amp
MB	Syscon, Y/C Jungle, Comb Filter,
VB	Velocity Modulation and Quadrapole

27” and Over

Board Name	Description
A	Power Supply, A/V Inputs, DGC, Tuner, Pincushion, H Deflection, V Deflection, Audio Amp
K	Audio Processor and SRS Processor
CA	CRT Drive and N/S Amp
MA	Syscon, Y/C Jungle, Comb Filter, Sub tuner
D	Dynamic Focus and Quadrapole Focus
HA*	Front A/V Inputs and Menu Switches
HB*	IR detector
HX	All Switches except KV27FV16
B Board*	3D Comb Filter,
P Board	PIP Processing
VA	Velocity Modulation and Quadrapole

*Found in KV27FV16 only.

The differences in layout between the 24” and below and the 27” and above models are the addition of the B, P and D boards for the added circuits. The switches, IR detector and front video input have been moved from the A board to the H boards due to the increased cabinet size.



24 Inch and Under

B board
CA board
VA board
D board
P board
K board
A board

27 Inch and Over
(KV-27FV16 pictured)

Overall Block

Overview

The BA-5 chassis is new for the 2000 model year. It is the first of the BA type chassis to cover 13" to 32" models using the FD Trinitron tubes. In order to accomplish this, parts common to all models are on one board, the A board. The MA or MB board contain the video processing and Syscon sections. If the set contains surround sound audio then it will have a K board. CA or CB boards contain the CRT Drive and Velocity Modulation. All 27" and above models contain a D board. Some 27" and above sets contain P and B boards which plug into the MB board. These boards are for PIP and a 3D Digital Comb Filter.

A Board

Power Supply

The A board contains sections that are common to all models. It contains the standby and switching power supplies. The Standby supply is an Energy Star complaint switching supply. It produces 7.5 volts to be used by the MA AND MB board. The MA AND MB board contains a 5V Regulator to power the System Control IC. The main switching supply produces +135 volts, Audio B+ and low voltage supplies. The low voltage supplies are +12, +9 and +5 volts.

The A board contains a degaussing circuit which is activated by the DGC line from System Control. This line controls a relay, which when activated, supplies 120 VAC to the degaussing coil.

Audio

The audio section on the A board contains the audio output amplifier. There may also be a switching IC that selects the correct audio input if the unit does not contain a K board. Any unit that features surround sound audio or SRS will have a K board.

Video

The A board contains front and rear input jacks and the main tuner. 24" inch and under sets will have a video input select switch on the A board. In other models, the video switching will be handled by the YCJ on the MA board.

Deflection

The horizontal, vertical and pincushion correction circuits are contained on the A board. These circuits control the current through the yokes in order to correctly scan the CRT. The FBT produces supply voltages for the vertical output and creates high voltage, focus voltage and G2 screen voltage. Pulses are monitored by the H protect circuit. If these pulses become too large, they will activate the latch circuit which will shut down the supply.

MA or MB Boards

The MA AND MB boards contain the YCJ and System Control circuits. The MB board will be used on all 24" and under sets. All 27" and larger sets will use the MA board. These boards use different YCJ and System Control ICs. The different YCJ allows for more inputs and also controls video switching in the larger sets. In addition, the larger sets contain a different System Control IC that is utilized to produce a better OSD and menu system.

In models that have the PIP function, a 2nd Tuner and a P board will be added to the MA board. The P board creates the sub picture using the video from the 2nd tuner.

The KV27FV16 contains a 3D Comb Filter that resides on the B board. The B board plugs into the MA board similarly to the P board.

CA or CB Boards

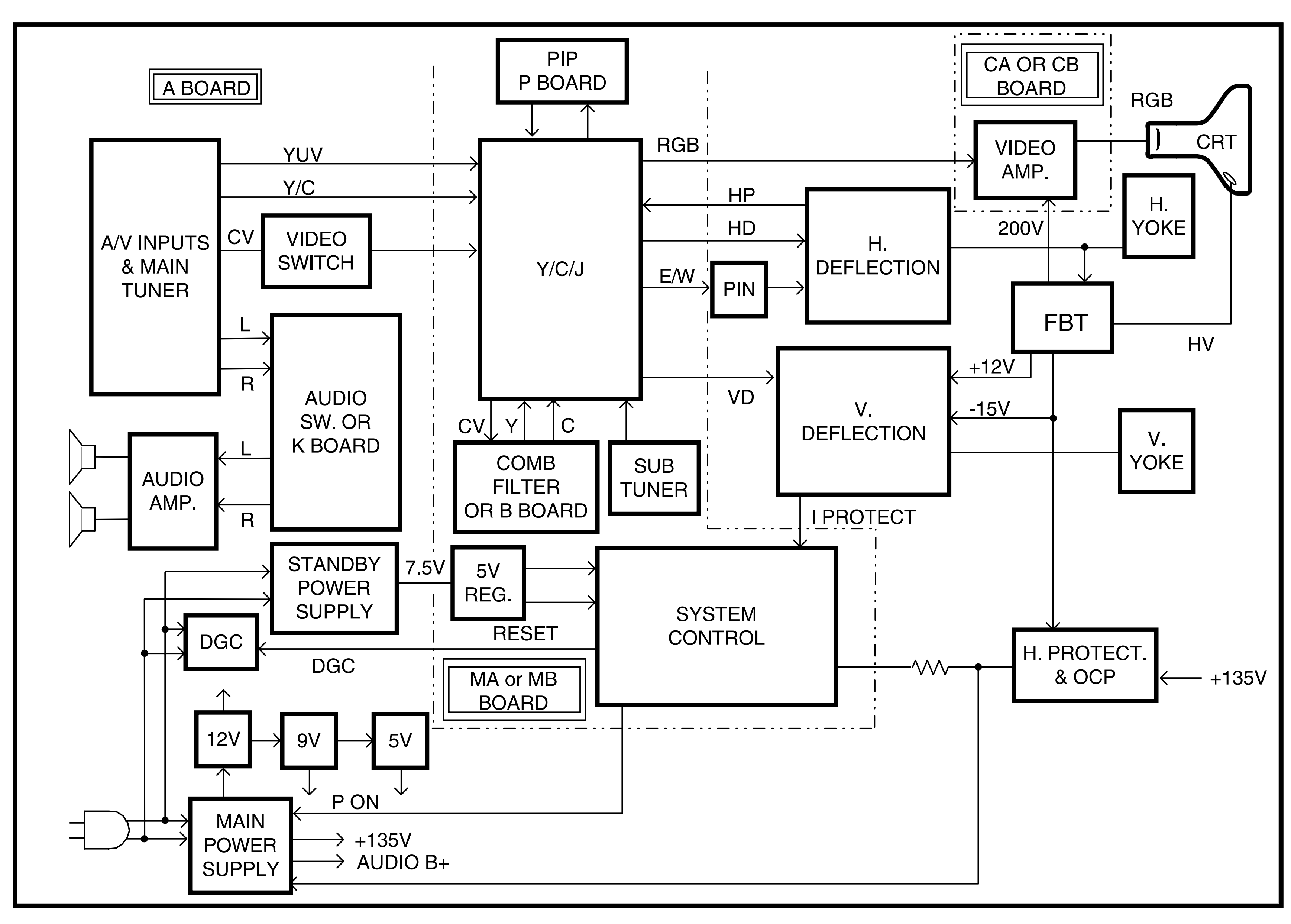
All 24" and under sets will contain the CB board. The CB board includes the CRT Drive and North/South Drive for tilt correction. The similar CA board will be used on all 27" and over models.

VA or VB Boards (Not shown)

All sets contain a VA or VB board, which contains VM Drive.

D Board (Not shown)

Larger sets will contain a D board. This board contains Quadra-pole and Dynamic Focus circuits necessary to produce a better picture on larger screen size models.



OVERALL BLOCK

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Power Supply and Self-Diagnostics

Power Supply

When the unit is first plugged in, power is applied through the AC In block to the Standby Supply. The Standby Supply powers the System Control IC, EEPROM, remote sensor and reset circuits. If a Power ON command is received after reset, the System Control IC outputs voltages to turn ON the Power and Degauss relays. When operating correctly, the following can be observed in sequence:

- The power relay clicks;
- One second later the degauss relay clicks and the hum of the DGC is heard for about two seconds; and
- The degauss relay clicks again two seconds later and then a picture is displayed.

This entire sequence occurs in the first 5-10 seconds the unit is powered ON. During this time, the Standby/Timer LED will be flashing approximately once per second.

The main power supply in the BA-5 chassis uses one switching IC to control switching of the B+ through a transformer. The transformer primary couples the signal to the secondary. The secondary signals are used to create three DC voltages, which are used to supply power to the rest of the set. Feedback from the primary side of the transformer and the +135 volt line created by the secondary are used to control the switching frequency. The IC also has three built-in protection circuits. They are for over voltage, over current and thermal protection. These protection circuits will be covered in the Switching Power Supply section.

Protection

Protection circuits are included to deactivate the set if the following failures occur:

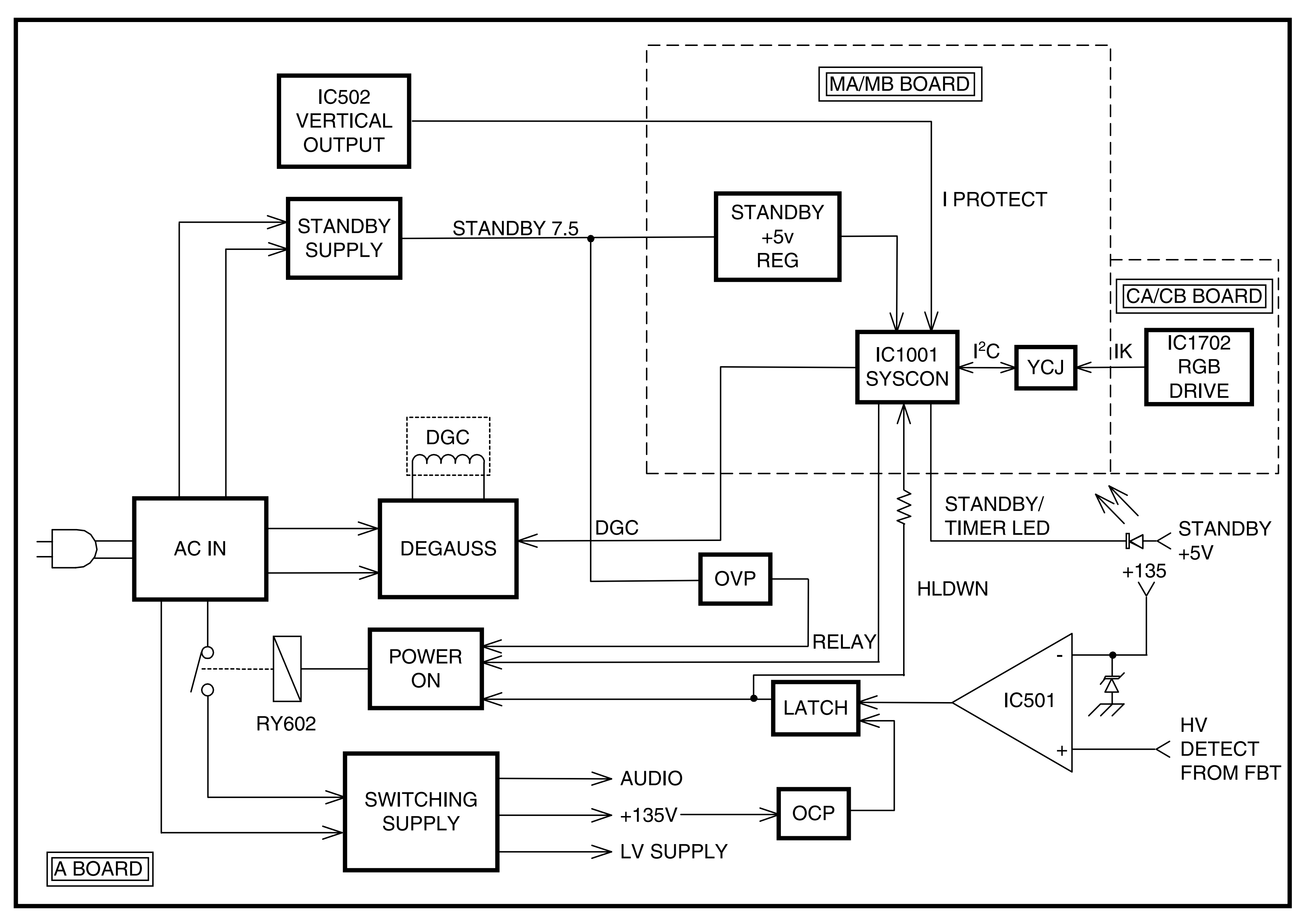
Standby +7.5 volt OVP – If over voltage occurs on this line, a LOW will be output to the base of the relay drive transistor. This shuts the set OFF.

+135 volt OCP – This sensor monitors the voltage across a resistor that feeds the H Out and FBT and protects against +135 volt OCP. When OCP is detected, the protect latch is activated. When the latch is activated, drive to the relay is stopped. This shuts down the main power supply. A signal is also sent to the Syscon IC to be used by the Self-Diagnostics.

H Protect – Or hold down is used to keep the picture tube from emitting harmful x-rays if a failure should occur that causes the High Voltage to rise. When this circuit is activated, it also turns the latch ON. This turns drive to the power relay OFF and sends a signal to the Syscon to be used for self-diagnostics.

AKB Protect – Or IK protect causes the video to be blanked if the YCJ does not receive the correct feedback from the IK line. The IK line's voltage is representative of the amount of current being drawn by the tube. This current is monitored during vertical blanking. The YCJ outputs one H line for each color and monitors the returning IK voltage. If this voltage is not within the correct operating window, the YCJ alerts the Syscon IC via the I^2C bus for use by the Self-Diagnostics.

I Protect- I protect occurs when the Vertical Output IC does not return samples of its pump-up pulse to the Syscon. When these pulses are missing, it is an indicator that the vertical section is not working. The Syscon IC monitors these pulses for Self-Diagnostics and protection purposes. When the pulses are missing, the main power supply is turned OFF and Self-Diagnostics are activated.



POWER SUPPLY AND SELF-DIAGNOSTICS BLOCK

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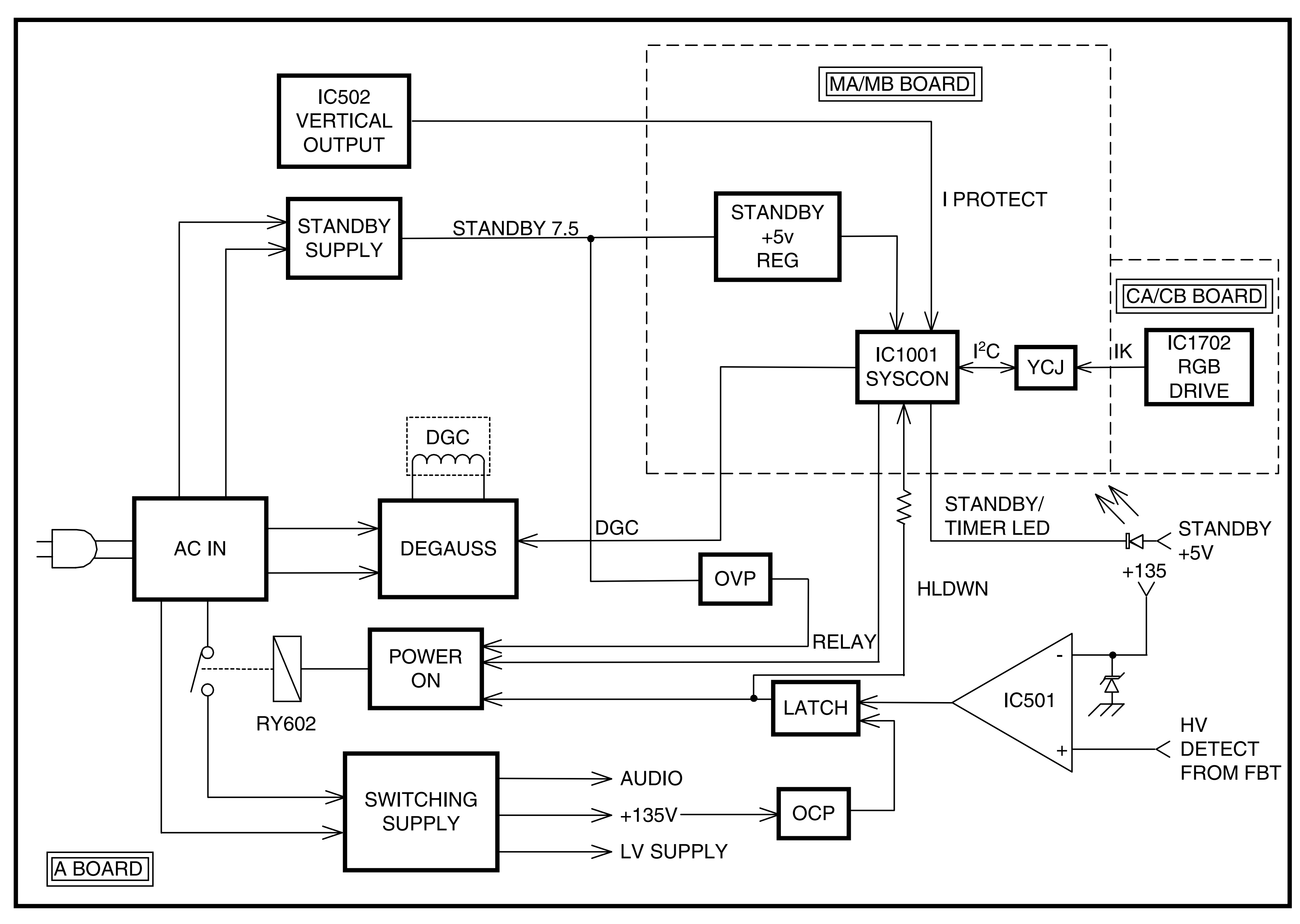
Self Diagnostics

The table below shows the number of times the Standby/Timer LED flashes in sequence before pausing and repeating. The table indicates what will happen when failures occur while the set is operating.

Standby / Timer LED Diagnosis		
Standby/Timer LED Blinks	Symptom	Problem
2 times, pauses and repeats.	Shutdown.	B+ OCP or H Protect
4 times, pauses and repeats.	Shutdown.	Vertical Failure (may also be Horizontal Failure or Power Supply since loss of either will cause no vertical.)
5 times, pauses and repeats.	1. No video 2. Sound OK.	White balance failure, weak picture tube or Low G2 voltage.
Continues to blink once a second.	No or defective Y/C Jungle IC301 communications.	No reply from Y/C Jungle IC (data bus is busy, grounded or held HIGH) or IK video path is defective at turn ON.

The set will usually act differently from what is shown in the table when it is powered up with a defect present. However indications will still be given that can guide you in troubleshooting.

In the case of intermittent problems, you can check the failure status history by pressing the Display, 5, Vol. – and Power buttons. You will see a menu that indicates how many times each item has failed. The failure information is stored in the EEPROM.



POWER SUPPLY AND SELF-DIAGNOSTICS BLOCK

4CTV27 4/25/00

Power ON/Degaussing

Overview

The Power ON/Degaussing circuit shown also includes the AC input and Reset circuits. When the unit is first plugged in, power is applied to the line filter to the Standby Supply. The Standby Supply powers the System Control IC, EEPROM, remote sensor and reset circuits. After reset, if a Power ON command is received, the System control IC outputs voltages to turn ON the Power and Degauss relays. When operating correctly, the following can be observed in sequence: the power relay clicks, one second later the degauss relay clicks, the hum of the DGC is heard for about two seconds, the degauss relay clicks again two seconds later and then finally a picture is displayed. This entire sequence occurs within the first 5-10 seconds the unit is powered ON.

AC Input

The AC is input to the A board through CN602. The Hi side of the AC line passes through T602/1 and 2, and R605 and R606. These resistors are inrush current limiters. They will be replaced with jumpers in all 24" and above models. The Lo side of the line passes through T602/4 and 3. After this occurs, AC is applied to the following three circuits. They are the Standby Power Supply, the Main Switching Supply and the Degaussing Circuit.

Standby Supply

The Standby Supply is similar to the one used in the AA2W chassis. There is an excerpt from CTV-26 included in the Appendix**. Keep in mind that the circuit is the same functionally, but the component identities will be different**. When AC is applied to the Standby Power Supply circuit, it begins to operate and outputs 7.5 VDC. This Standby 7.5 volts is applied to the MB board via pin 3 of CN2002 and CN1004. This voltage is input to IC1305/4. IC1305 is a 5V Regulator that also outputs the 5 volts to be used for reset. The Standby 5 voltage is output IC1305/5 to IC1001/27 Vcc. The reset 5 volts is output IC1305/2 to IC1001/30 Reset through a RC network. This RC network provides the delay necessary for Reset to occur. After Reset occurs, IC1001 Control Tuning System begins executing instructions. One of its first tasks is to read and load the contents of the external NVM into the registers of IC1001 via the I^2C bus. The data in the NVM contains the service data as well as any data relating to customer control settings such as volume level.

Power ON

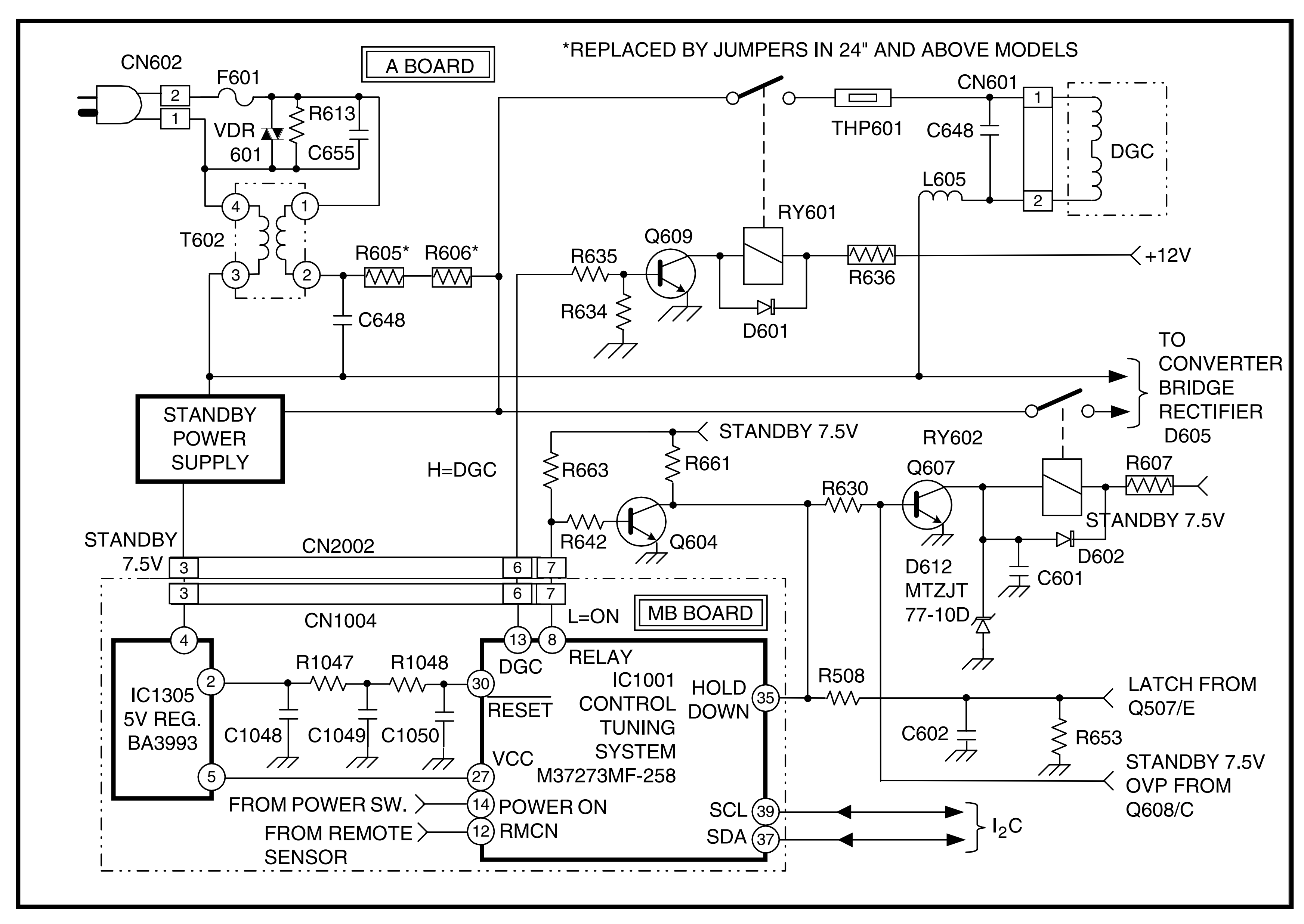
When the Power On command is received from the Power Switch or the remote control, IC1001/8 Relay goes LOW. This LOW is sent to the A board via pin 7 of CN1004 and CN2002. It is then applied to Q604/B, turning Q604 OFF. When Q604 is OFF, the Standby 7.5 volts is applied to the base of Q607 through R661 and R630. This turns Q607 ON and allows current to flow through RY602, which causes the contacts in RY602 to close. When the contacts close, AC is applied to D605 Bridge Rectifier. This allows the Switching Supply to begin to operate. When the switching supply is operating, the set should be ON.

Degaussing

About one second after the Power Relay is closed, the Degauss Relay is closed. This occurs because IC1001/13 outputs a HIGH, which is sent to the A board via pin 6 of CN1004 and CN2002. It is then applied to Q609/B. This turns Q609 ON, allowing current to flow through RY601 Degauss Relay. This closes the contacts of RY601 and allows current to flow through THP601 and the DGC. This action is accompanied by the sound of the DGC humming. Current flows through the DGC until THP601 becomes warm. THP601 is a thermistor and its resistance increases rapidly as its temperature increases. Its resistance will increase so much that after about two-three seconds, current flowing through the DGC will be greatly reduced. After about five seconds, IC1001/13 DGC goes LOW and the Degauss Relay is turned OFF.

Shutdown

The outputs from the Latch and the Standby 7.5 volt over voltage protection circuit are connected to either side of R630. If either circuit goes low, the power relay will turn OFF. The LOW from the latch circuit will also be applied to the HLDWN line, which is input to IC1001/35 for use by Self-Diagnostics.



POWER ON/DEGAUSSING

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Inrush Current Protection

Overview

Sets with 20-inch tubes and below use R605 and R606 (shown in the Power ON/Degaussing section) for inrush current protection. Since more current is drawn when a set with a bigger CRT is turned ON, an alternate inrush current circuit is used for sets with 24 inch and larger CRTs. The resistors in smaller sets remain in place after turn ON. The larger sets use a resistor that is shunted by an SCR shortly after power ON. This allows more current to be drawn without dissipating more power.

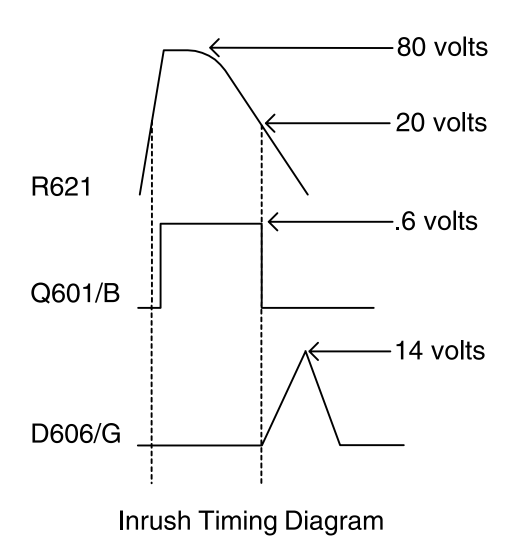
In Rush Current Protection

RY602 is closed when the set is turned ON. This applies AC to D605 Bridge Rectifier and R637. D605 Bridge Rectifier supplies DC to the switching supply through R626. R621 is added in order to keep excessive current from being drawn by the switching supply at initial turn ON. R621 is placed in series between the negative terminal of D605 Bridge Rectifier and hot ground. This resistor is not in place in smaller sets that contain R605 and R606. The negative terminal of D605 Bridge Rectifier is connected directly to hot ground in these sets.

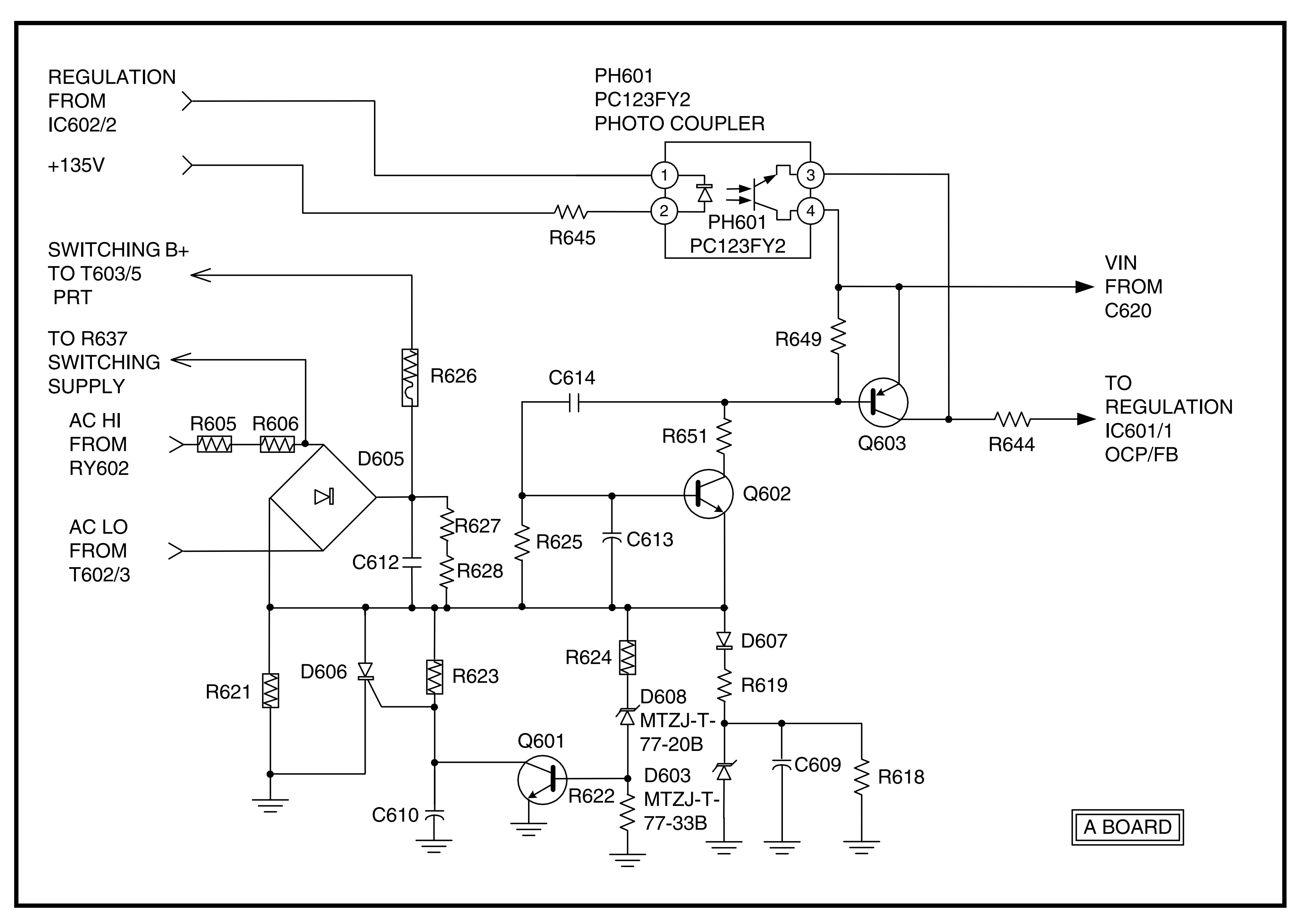
D606 is a thyristor that is connected across R621. When the set is turned ON, 80 volts is developed across R621. This initial voltage causes D608 to conduct since its zener voltage is 20 volts. When D608 is conducting, Q601 is ON. Q601 keeps C610 from charging when it is ON. As the initial inrush current begins to dissipate, the voltage across R621 decreases. When this voltage drops below 20 volts, D608 turns OFF, causing Q601 to turn OFF. When Q601 turns OFF, C610 begins to charge. When the charge of C610, a 10-uf capacitor, reaches about 14 volts, D606 begins to conduct. After this occurs, the voltage drop across R621 becomes only a few tenths of a volt.

D603 is a 33 volt zener used for protection. It is not activated during initial turn ON because C609 needs to charge. C609 is a 100-uf capacitor. C609 will not charge to a level of 33 volts before D606 turns ON. This keeps the circuit from activating at power ON.

In the event that there is a problem such as D606 opening during operation, C609 will charge and D603 will turn ON. When D603 turns ON, current flows through D607 and R619. This causes Q602 and Q603 to turn ON. When Q603 turns ON, the VIN voltage from C620 is applied to IC601/1 through R644. This causes IC601 to activate its own OCP circuit, stopping the supply from switching. If a failure of this nature were to occur for a very short time, less than four seconds, the supply could restart itself. If the failure lasted longer, a sequence of four flashing Standby/Timer LED followed by a pause would occur and the Power Relay would be opened. The Standby/Timer LED will continue to flash in the above sequence until power is removed from the set. This removes power from the supply and it ceases to function. **This is an indication that there is a vertical failure when actually there is a problem in the power supply.**



Inrush Timing Diagram



INRUSH CURRENT PROTECTION (24" AND ABOVE)

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Switching Power Supply

Overview

The power supply in the BA-5 chassis uses one switching IC to control switching of the B+ through a transformer. The transformer primary couples the signal to the secondary. The secondary signals are used to create three DC voltages that are used to supply power to the rest of the set. Feedback from the primary side of the transformer and the +135 volt line created by the secondary is used to control the switching frequency. The IC also has three built-in protection circuits.

Startup

When power is turned ON, RY602 is closed and AC is applied to R637 and D605. The AC applied to R637 is passed through R662 and R660, and applied to IC601/4 VIN. As C620 charges on the first positive half cycle of the incoming AC signal, its voltage reaches the threshold at which IC601 Converter will start to operate. This threshold is around 11 volts. Once IC601 starts operating, the incoming AC will not be a factor in sustaining the charge of C620. The voltage at IC601/4 VIN will remain at approximately 17 VDC during normal operation due to a sustaining voltage, which will be created using the signal from T603/7.

When AC is applied to D605, 144 VDC is developed. This voltage is sent through R626 to T603/5. When the voltage across C620 is sufficient to allow IC601 to operate, current flows through T603/5 and T603/4, and T603/3 and T603/2, through IC601/3 D and IC601/2 S, and finally through R632 and R641 to ground. IC601/3 and 4 are the Drain and Source for an internal FET. The gate of this internal FET is connected to an oscillator contained in IC601 Converter. When the voltage threshold for startup is reached at IC601/4 VIN, the oscillator begins operation by outputting its positive half cycle. This turns the internal FET ON, allowing current to flow as described above. When the oscillator starts its negative half cycle, the FET is turned OFF and current stops flowing through T603/4 and 5 and T603/2 and 3.

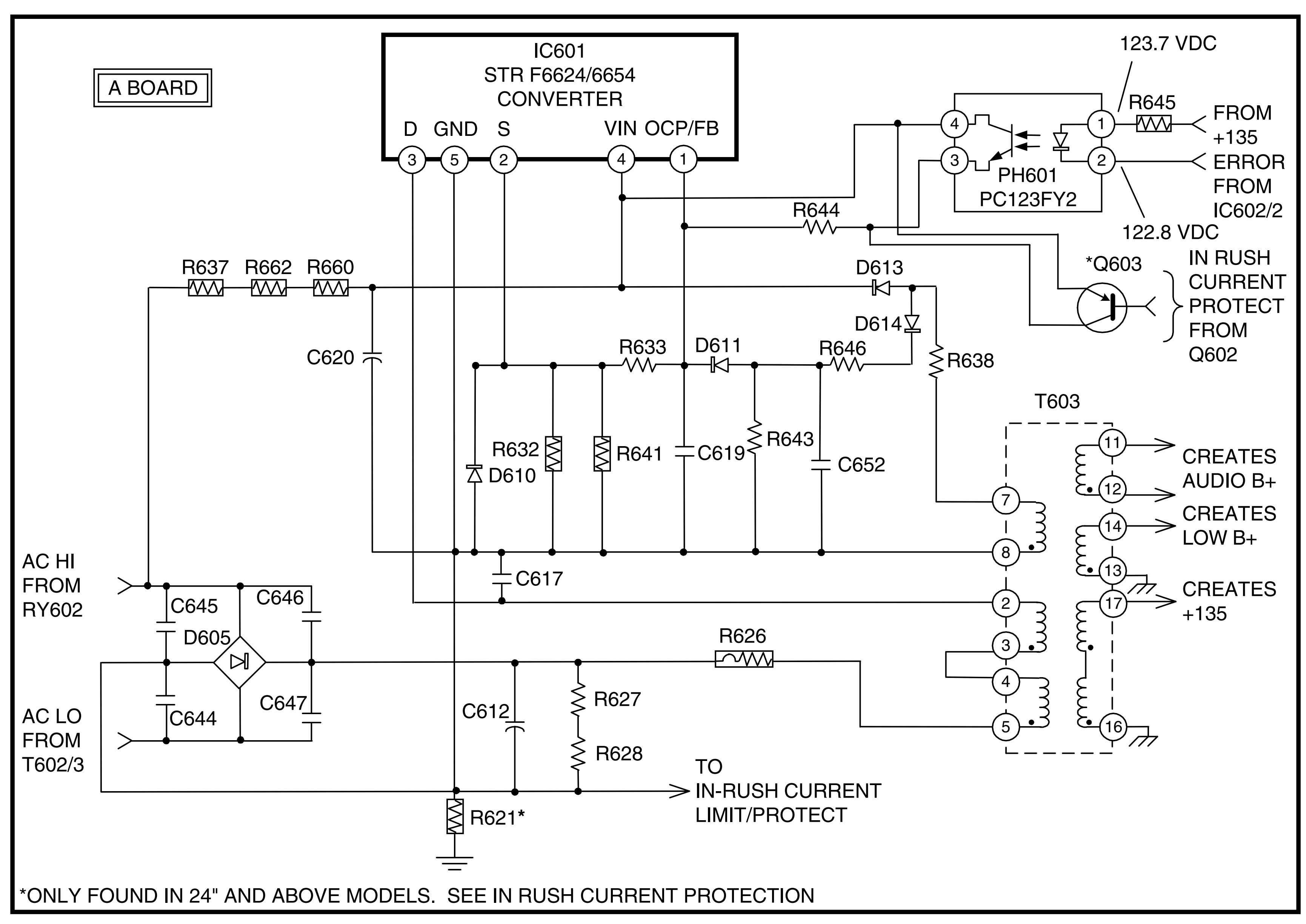
This switching ON and OFF of the internal FET, whose Drain and Source are IC601/3 and 2 respectively, produces a signal output at T603/7 that is rectified by D613 and applied to IC601/4 VIN. The DC voltage produced by D613 is used to sustain the input voltage at IC601/4 VIN.

When this sustaining voltage is missing, IC601 will begin to start up. Without this voltage, C620 will discharge on the negative half cycle of the incoming AC. This causes the IC601 to be constantly turned ON and OFF. A chirping noise accompanies this failure and the Standby/Timer LED will flash. If the voltage supplied to IC601/4 VIN exceeds 22 volts, the IC will go into internal over voltage shutdown and cease oscillation.

Regulation

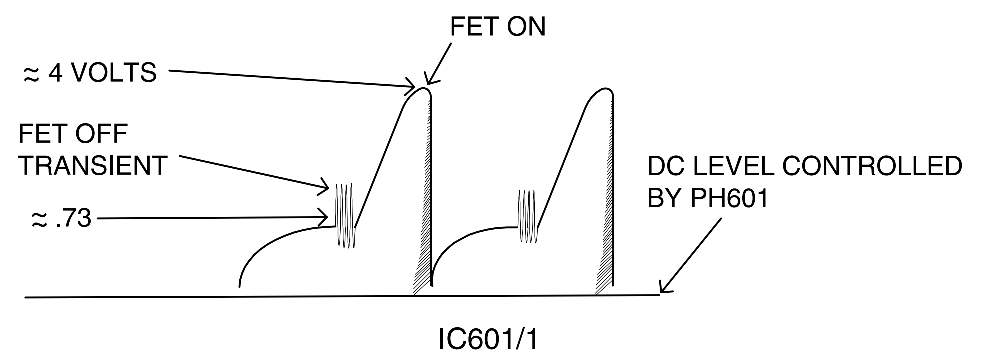
IC601 Converter is used here in quasi-resonant operation. Quasi-resonant refers to the fact that there are two different levels used to determine how long the internal FET of IC601 should be turned ON or OFF. The resistance and capacitance values of the components associated with IC601/1 and 2 determine this.

When the supply is started, the voltage created across R632 and R641 monitors the current through the internal FET. This voltage is fed to IC601/1 through R633. This pin is connected internally to two internal comparators. When this voltage reaches .73 volts, Comparator 1 in IC601 Converter turns the internal FET OFF. When this occurs, a positive going signal is produced at T603/7 due to the collapsing magnetic field. This signal is rectified by D614. The rectified voltage is delayed by the charging action of C652. The delay time is a factor of the values of R646, R643 and C652. The rectified and delayed voltage from D614 is then sent through D611, blocking diode, to IC601/1 OCP/FB. When this voltage reaches approximately 4 volts, Comparator 2 in IC601 turns the FET ON. This causes a loss of the D614 voltage due to the changes in magnetic field of T605. The voltage across R632 and R641 will increase again and the cycle repeats itself.



SWITCHING POWER SUPPLY

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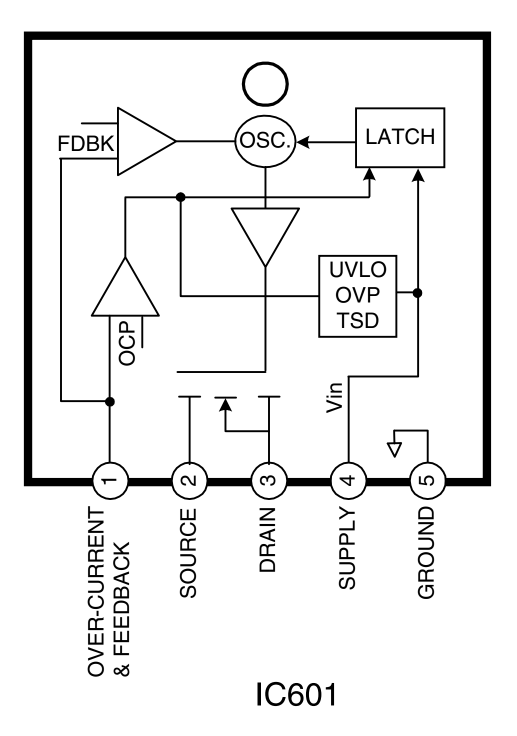


IC601/1

PH601 is an opto-isolator. Pins 1 and 2 are connected to the +135 volt line and to IC602/2 Error Amp. These pins are the terminals of an LED. Variations in the +135 volt line effect how much light is output from the LED. Pins 3 and 4 of PH601 are the emitter and collector of the internal phototransistor. The brighter the light from the LED, the more current can flow through the C-E junction. When there is conduction, C-E voltage from IC601/4 VIN is applied to IC601/1 OCP/FB through R644. This DC voltage helps regulate the supply by changing the DC level of the signal created by the quasi-resonant operation. Changing the DC level alters the ON/OFF time of the internal FET. This in turn changes the frequency of operation. By controlling the frequency, the power transfer is controlled between the primary and secondary windings of T603. This regulates the supply's output, which means regulation is maintained by frequency control.

The table below shows the typical operating frequency checked at IC601/3, and the IC601/1 voltage under maximum (white raster) and minimum (black raster) loads.

	+135	Frequency	IC601/1 DC Voltage
White Raster	135.6 DCV	145kHz	1.71 VDC
Black Raster	136 DCV	200kHz	1.6 VDC



IC601

IC601 Internal Protection

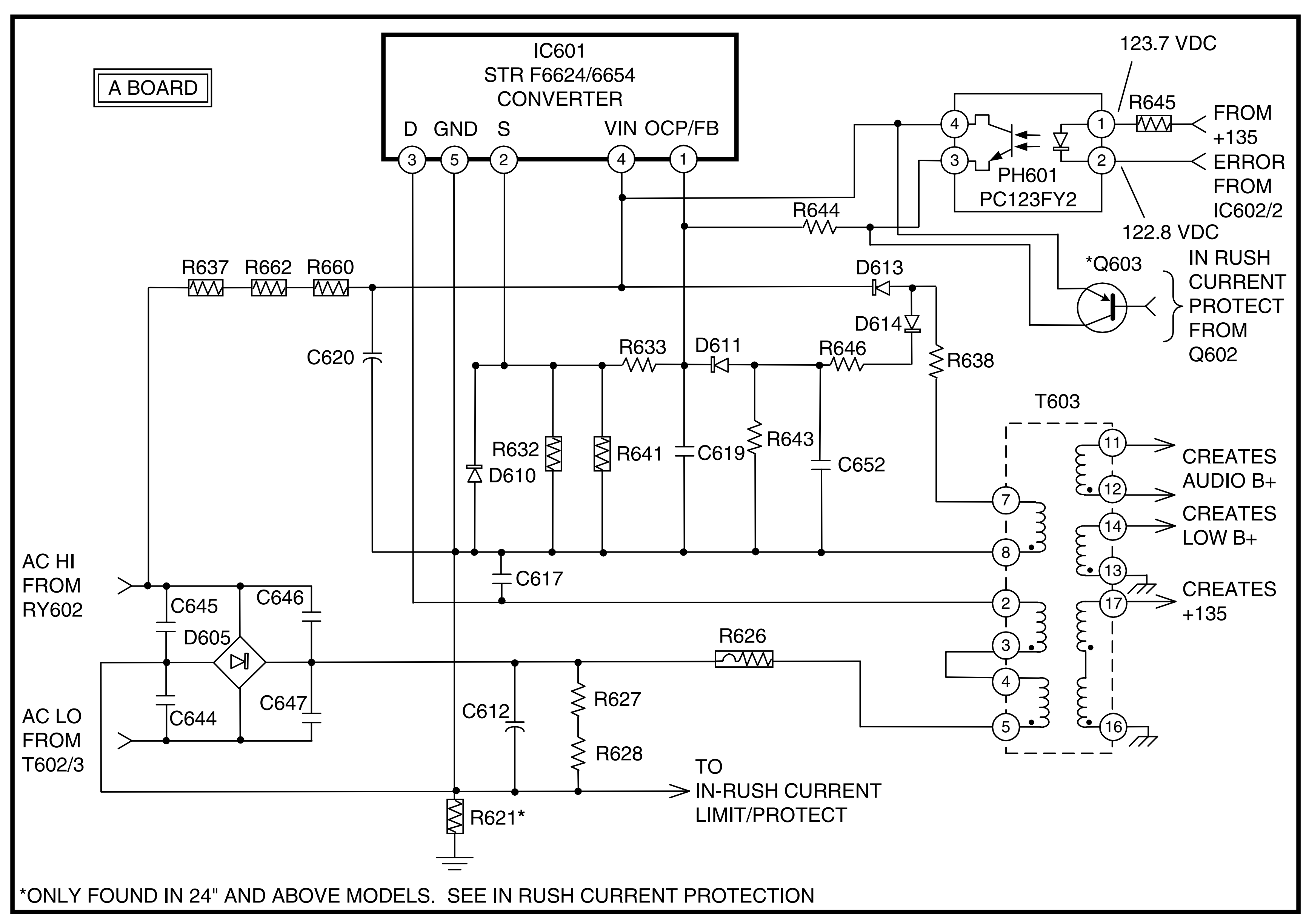
IC601 has three protection circuits. They are over voltage, over current and thermal protection.

OVP

The over voltage protection circuit functions by monitoring the voltage present at IC601/4 VIN. If this voltage rises above 22.5 volts, the switching circuit will be stopped. This OVP activates a latch circuit and power must be disconnected for operation to restart.

OCP

Over current protection is done by monitoring the voltage at IC601/1 OCP/FB. IC601/1 OCP/FB only operates during the turn ON portion of the FET switching. If the voltage passes over the threshold during this time, switching will stop. This will cause the voltage at IC601/4 VIN to fall below the voltage needed to operate the IC. This voltage will rise above the operating threshold on the next positive half cycle of the AC input and cause the FET in IC601 to turn ON. If OCP is detected again by IC601/1, the cycle



SWITCHING POWER SUPPLY

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will repeat. Every time this cycle repeats, a chirping sound can be heard from the power supply. This chirp occurs when the VIN voltage rises again to a voltage at which IC601 can operate. This chirping sound is made each time the supply begins to restart. It will continue to repeat until the Syscon IC senses a vertical failure. At that time the power relay will be turned OFF and the Standby/Timer LED will flash in sequences of four.

An example of this failure would be a short on the 135-volt line such as VM Output short. This type of failure would not be associated with a Horizontal failure such as H Out, 200-volt short (Video Amp) or FBT. That circuit contains another OCP that would cause the Standby Timer LED to flash in sequences of two. This will be discussed later.

Thermal

The thermal shutdown works by sensing the temperature of the lead frame that the IC is mounted to internally. The semiconductor wafer is mounted to a lead frame to dissipate heat. When the temperature of the frame reaches 140 degrees Celsius, the latch is activated. Power must be disconnected for operation to restart.

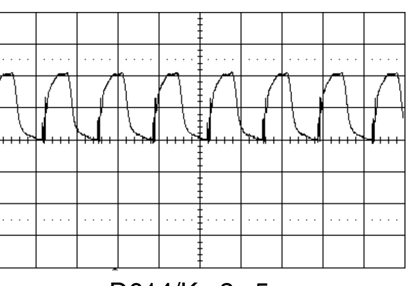
Operating the Supply without a Load

It is important to be able to isolate whether a problem is in the power supply or other circuitry. This supply can be run unloaded at AC input voltages ranging from 30VAC to 120VAC.

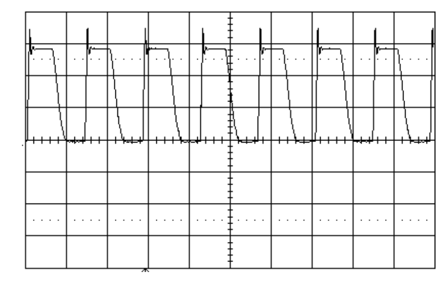
You can unload the supply by unsoldering one side or removing L603. After removing L603, place a jumper across the contacts of RY602. Plug the set into a variac and begin to slowly bring up the AC voltage. At about 30 volts, the supply will begin to operate. The following table shows the state of several points at various AC input voltages:

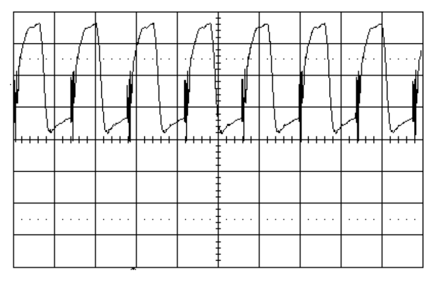
	IC601/1	**IC601/3**	**IC601/4**	**Switching B+**
40VAC	.87 VDC	160 Vpp	12 VDC	51 VDC
60VAC	.98 VDC	200 Vpp	12.83 VDC	79 VDC
80VAC	1.11 VDC	230 Vpp	13.2 VDC	106 VDC
100VAC	1.21 VDC	260 Vpp	13.5 VDC	134 VDC
120VAC	1.22 VDC	280 Vpp	13.9 VDC	163 VDC

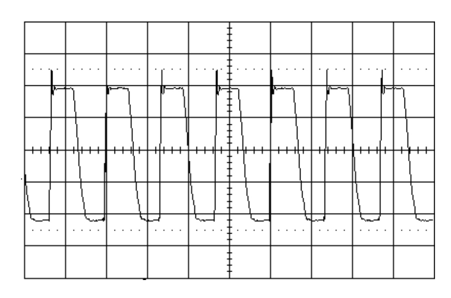
You should also note that under the above conditions the +135 volt output at L603 remained at 136 volts throughout. The signal seen at IC603/3 started as sine waves clipped at the negative peaks and gradually came to look more like a normal sine wave as the input voltage was increased. The frequency of this signal ranged from 236 kHz at 40 VAC to 320 kHz at 120 VAC.

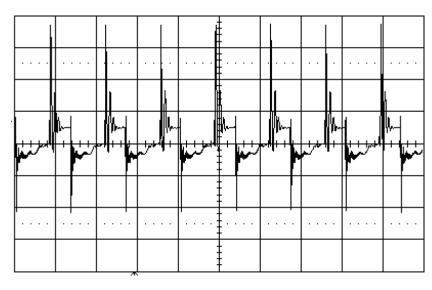


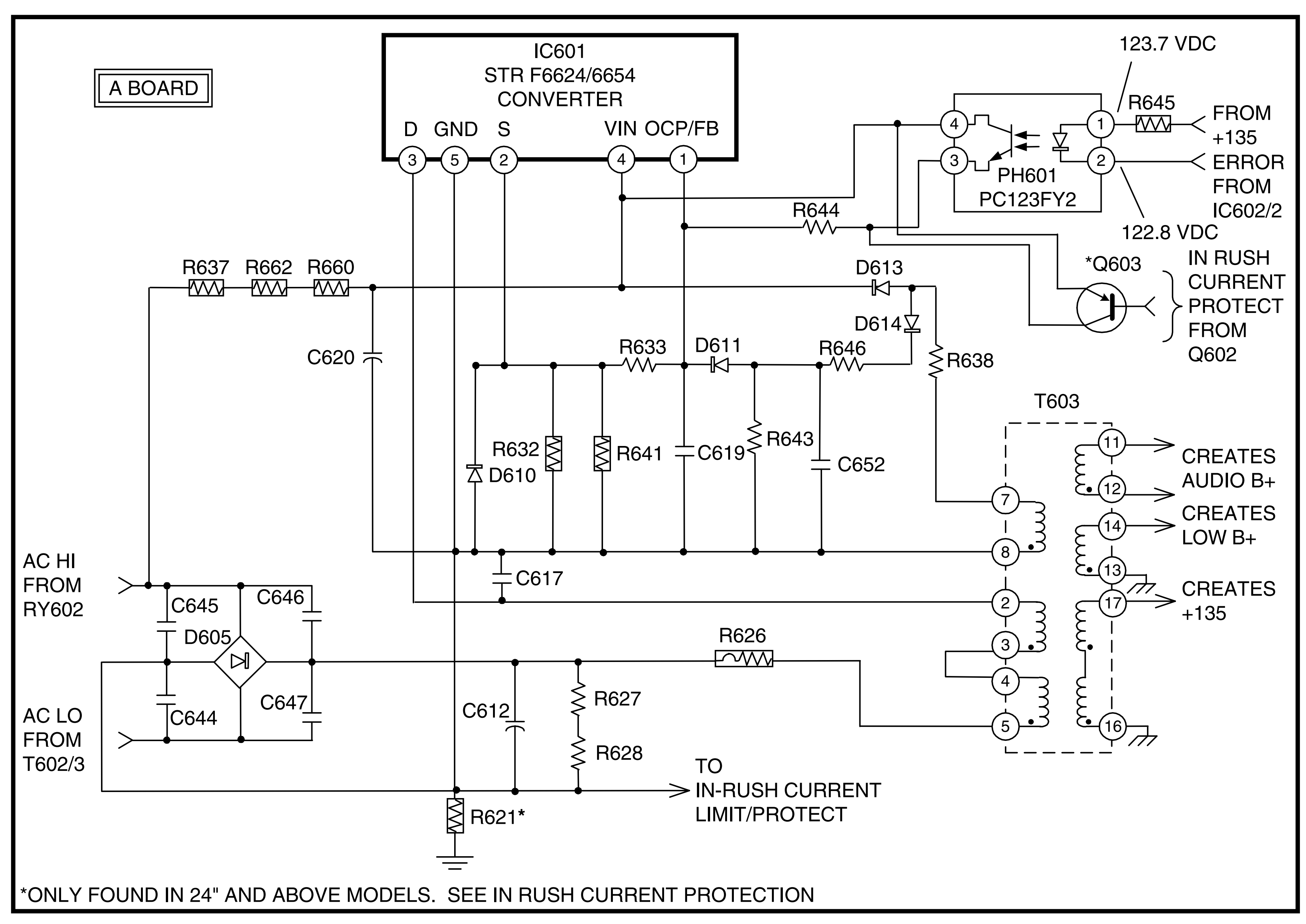

D614/K 2v 5us


IC601/3 100v 5us


IC601/1 1v 5us


T603/7 10v 5us


IC601/2 1v 5us



SWITCHING POWER SUPPLY

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Troubleshooting

The following table is a list of symptoms that occur when any of the supply voltages are shorted to ground at turn ON. This may be helpful in troubleshooting. It is important that you take into account all the symptoms to aid in your troubleshooting,

Voltage	Relay Clicks	Video	Audio	Timer LED	HV	Power Switch	Suspect
+135	2 power On and Shutdown. Power supply chirps.	No	No	4	No	Set ON and symptom repeats	Q502, 200 volt problem, T503 FBT
+12	2 power On and Shutdown. Power supply chirps.	No	No	4	No	Set ON and symptom repeats	IC603 9 Volt Regulator, IC501 Pin and OCP
+5	4 clicks. Power ON, Degauss ON and OFF and Shutdown.	No	No	4	No	Set ON and symptom repeats	IC604 5 Volt Regulator, Data problem
+9	4 clicks. Power ON, Degauss ON and OFF and Shutdown.	No	No	4 the fourth flash stays on for several seconds.	No	Set ON and symptom repeats	IC603 9 Volt Regulator, IC1301 YCJ or IC301 Depending on model
Audio B+	3 Normal	Yes	No	Normal	Yes	Set turns OFF	PS401, 402 and IC401, 402 depending on model
+200	2 power On and Shutdown. Power supply chirps.	No	No	4	No	Set ON and symptom repeats	Q502, 200 volt problem, T503 FBT
+12 Scan Derived	4 Normal 3 then fourth for shutdown.	No	Yes	4	Yes	Set ON and symptom repeats	IC502 V Out, R550
-15	4 Normal 3 then fourth for shutdown.	No	Yes	4	Yes	Set ON and symptom repeats	IC502 V Out, R549

NOTES

+135 OCP and H Protect

Overview

The +135 OCP and H Protect detection circuits output a HIGH to indicate a problem. These HIGHS are input to the latch circuit that then places a LOW at the base of the relay drive transistor. This eliminates the current path necessary to keep the unit ON. When there is a failure, a signal is also sent to IC1001, which will indicate these failures by flashing the Standby/Timer LED in sequences of two.

Latch and Hold Down

The latch is activated whenever a condition in the +135 volt OCP or the H Protect circuits causes Q506/B to go HIGH. A HIGH on Q506/B turns it ON, causing it to turn ON Q507. This drops the drive voltage to Relay Drive Q607/B, turning it OFF. This in turn removes the ground return path for RY602 and the unit shuts OFF. During shutdown, the voltage from the Standby 7.5-volt line maintains the latch. You can determine which of the two circuits is activating the latch by checking the voltage at D520/A with a peak hold meter. If that voltage shows a peak near 5 volts, there is a problem with the OCP.

The LOW signal created by the latch is also applied to the HLDWN line through R508. The HLDWN line is connected to IC1001 at pin 35. Whenever this line goes LOW, the Self-Diagnostics are activated and the Standby/Timer LED flashes in sequences of two.

H Protect

When the horizontal circuit is operating normally, a signal is output from T505/7 that is also used to supply voltage for the –15 volt line. This signal is sent through R548 and D519 and is used to maintain the charge of C546. The DC voltage created by the charge of C546 is input to IC501/5 Non inverting input through R563. This voltage is compared to a reference voltage of 10.4 volts that is derived by a voltage divider consisting of R561, D517 and D518. D517 is used for temperature compensation. As long as IC501/6 is greater than IC501/5, the horizontal circuit is operating normally. The voltage at IC501/6 is proportional to the High Voltage. If the High Voltage becomes excessive, the voltage at IC501/5 will become greater than that at IC501/6. This would cause IC501/7 to output a HIGH. This HIGH voltage activates the Latch. **Note: This is a departure from the way previous models have worked. Typically when the H protect circuit was activated, it turned ON a transistor that grounded the HP input to the YCJ. In turn, the YCJ would disable HD.**

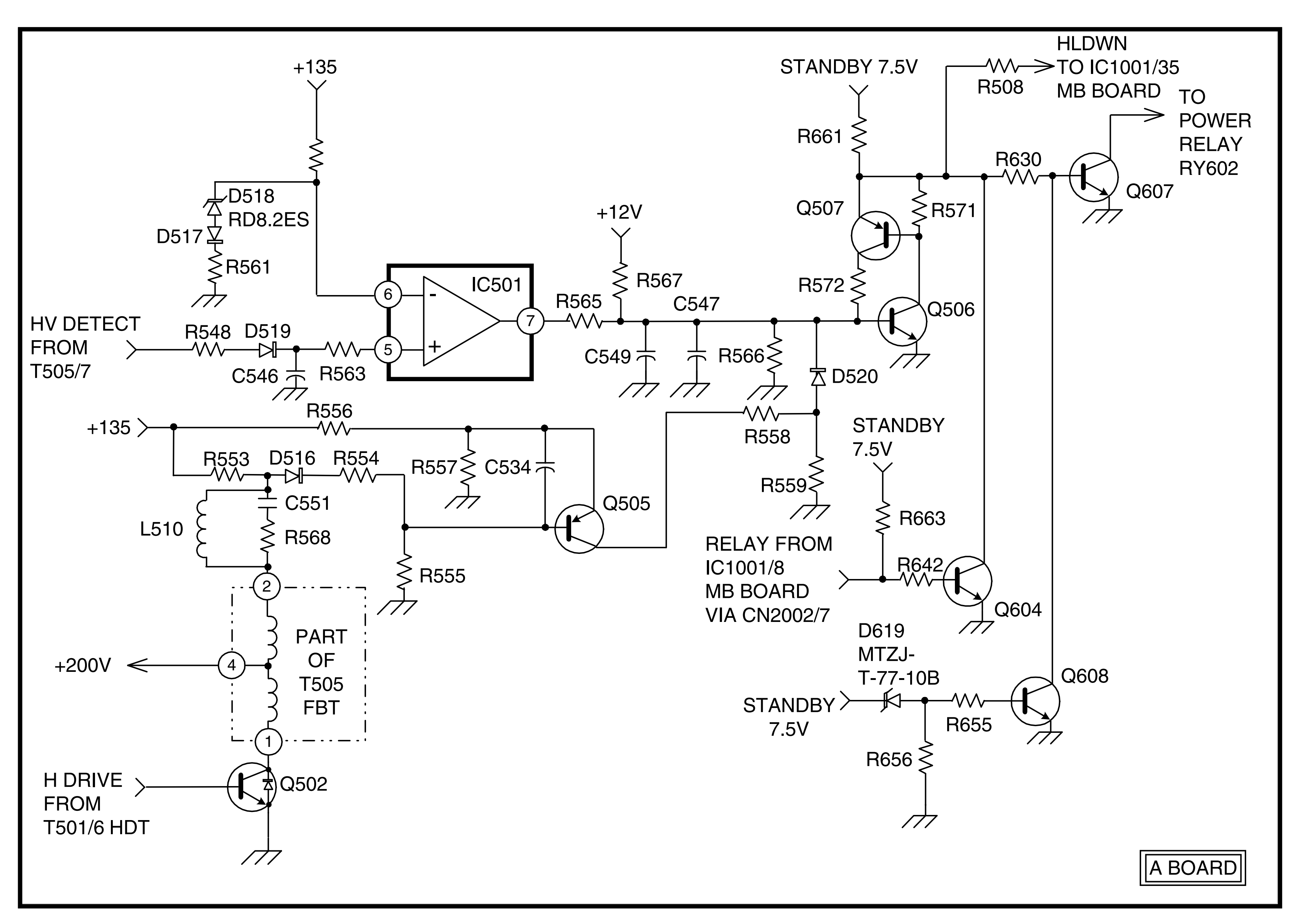
+135 Volt OCP

Over current is detected by monitoring the voltage across R556 and R553. When this voltage, which rises as more current is drawn, gets to a level that causes Q505 to turn ON, the latch will be activated. C534 prevents premature triggering of OCP.

Three main components generally cause this type of failure. They are T505 FBT, Q502 H Out and the CRT Drive (not shown). You should check Q502 with an ohmmeter first. This component usually fails with a C-E short. Unloading each of them from the circuit one at a time can eliminate these components. **Note: Before doing this, ensure that SW501 H Centering Switch is in the center position. Damage will occur to the set if it is not.**

- Unplug the unit. Start with the easiest by unplugging CN502 from the A board and reapplying power. If the symptom changes from sequences of two flashes to sequences of five flashes, replace IC702 CRT Drive on the C board.
- If the symptom remains, unplug the set, reconnect CN502 and remove Q502. Re-apply power. If the symptom changes from sequences of two flashes to sequences of four flashes, replace Q502.
- If the symptom remains, unplug the set and remove L510 and R568. These points were chosen because they do not have eyelets. Consequently they are easier to remove compared to unsoldering T505/2. This eliminates the T505 FBT. If the symptom changes from sequences of two flashes to sequences of four flashes, replace T505.

In very rare cases the protection transistor, Q505 in this case, has become leaky. This can generally be determined by checking the transistor with an ohmmeter or diode checker. It is also possible that IC501 has become faulty.



+135 OCP AND H. PROTECT

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Deflection Block

Horizontal

IC1301 YCJ generates the horizontal drive signal and outputs it from pin 34. This signal is first applied to horizontal drive transistor Q501 and is then applied to the horizontal drive transformer T501 and coupled to Q502, the Horizontal Output. The signal from the Horizontal Output is sent to the horizontal yoke and the FBT T505. The horizontal deflection yoke controls the beam scan horizontally. The Horizontal Output circuit also outputs a sample of the H output that is squared off. This signal is called HP. HP is returned to the Pin circuit, YCJ for H phase compensation, and the D board on applicable models to create certain signals used by Dynamic Focus and Quadra-pole.

T505 FBT boosts the horizontal drive signal to create the high voltage, G2, heater and focus voltages required by the picture tube. The FBT creates an ABL signal which is representative of the current drawn by the tube. This signal is used to limit the picture brightness and to compensate for high voltage regulation. In addition, scan derived power supplies are generated by the FBT. They are the +200, +12 and – 15 volts.

Pincushion

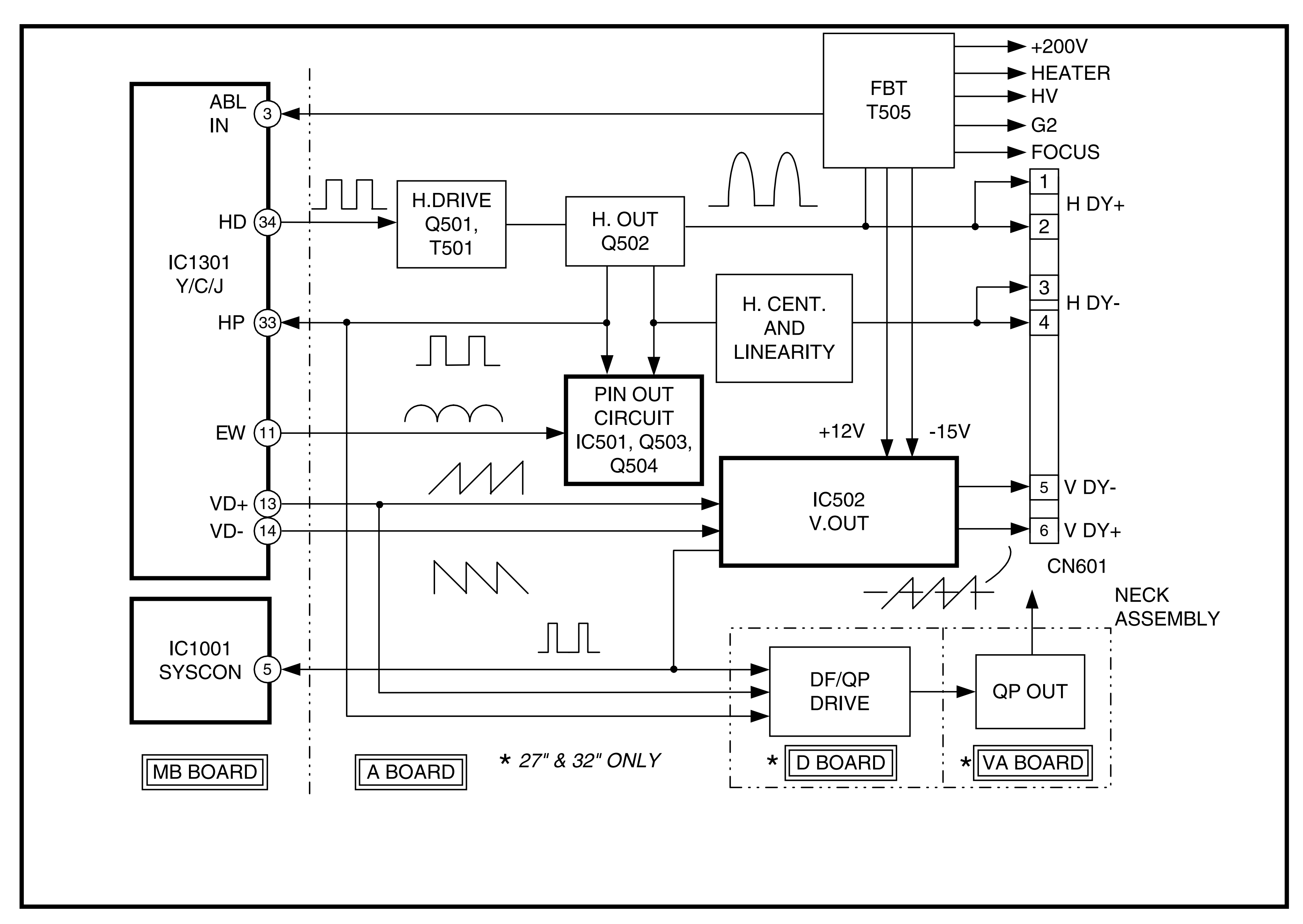
A 60 Hz parabola signal is output from the IC1301/11 E/W and applied to the Pin Out circuit. This signal is compared with the HP signal to create a Pulse Amplitude Modulated signal that is applied to the Horizontal circuit. The purpose of this signal is to create a uniform picture width on the screen

Vertical

The vertical drive signals are generated by the YCJ **after it successfully completes initial communication with the Syscon**. These signals are output from IC1301/13 and 14 and are applied to IC502 Vertical Out. The output from IC502 Vertical Out is applied to the vertical yoke to control the scanning of the beam vertically. The vertical output also generates a boost pulse that is returned to the Syscon IC for self-diagnostics. This boost pulse is also sent to the D board to create certain signals.

Dynamic Focus and Quadra-pole

The D board is used in all 27” and above models. This is because dynamic focus and Quadra-pole are necessary for larger FD Trinitron tubes. The dynamic focus control uses the VP and HP signals to develop a signal, which will be used to sharpen the left and right sides of the picture. The Quadra-pole circuit uses the VP and HP signals along with the positive vertical drive signal (VD+) to create a signal that will be applied to a series of coils. The magnetic field of these coils is used to sharpen focus in the four corners of the picture.



DEFLECTION BLOCK

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Horizontal Deflection

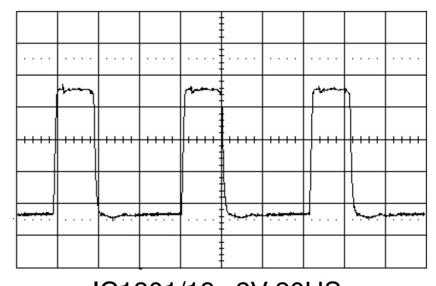
Overview

Since the Horizontal Deflection circuitry has changed little in the last few years, we will not discuss its circuit description. This section of the course will be used to offer troubleshooting tips for repairing BA-5 chassis sets.

Troubleshooting

The following is a procedure to try if the set is shutting down with a **four flashing sequence indication from the Self-diagnostics and No High Voltage presen**t. The presence of High Voltage for even a short time is an indication that the Horizontal circuit is functioning normally and your problem lies in the vertical section. Keep in mind the scan supplies are part of the Horizontal circuit.

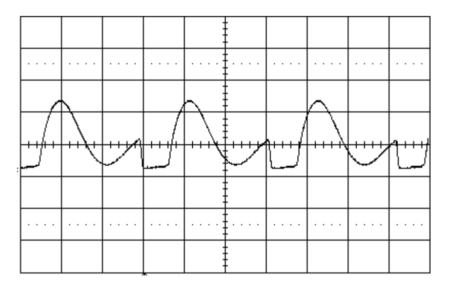
The YCJ should always output HD whenever 9 volts is present. You can check this by turning the set ON and checking IC1301/19 HD for the signal shown below before the set shuts down. Another method would be to remove the MB board and connect a +9 volt power supply to the 9-volt line. The HD signal should be output from pin 19.



IC1301/19 2V 20US

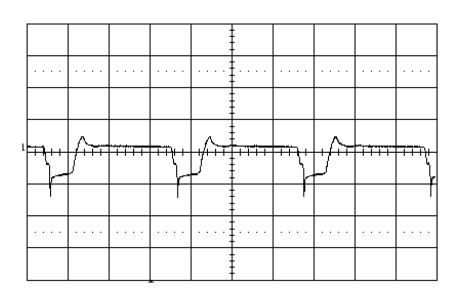
The only exception would be if IC1301/18 HP is shorted to ground. This pin serves a dual function in previous chassis. In those sets it is the HP/H OFF line. In these models, during an H protect condition, pin 18 would be grounded and HD at pin 19 would be halted. The H protect circuit does not operate in this manner in the BA-5 chassis, but should IC1301/18 HP be grounded, it would cause HD to cease. IC1301/18 HP should be checked for a short to ground in the event that the YCJ is not outputting HD.

If IC1301 YCJ is outputting HD, the next step is to see if this signal is present at the base of Q501 H Drive. If the signal looks good at Q501/B then the base of Q502 H Out could be unloaded by unsoldering 1 side of R504. This will determine if Q501 can output a signal with its load, T501, connected. The following waveform should be seen at R504 with Q502/B disconnected.

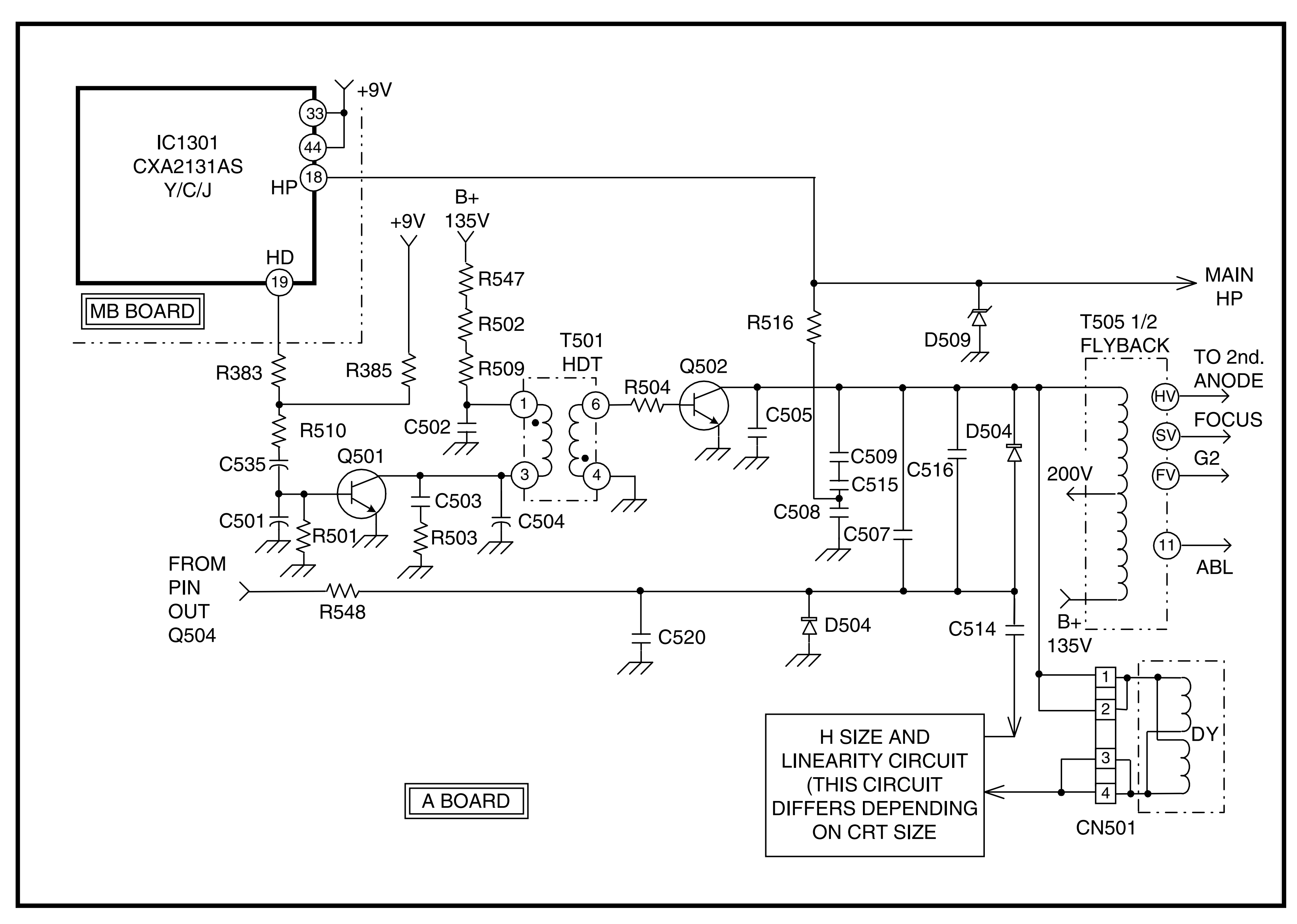


R504 with Q502/B unsoldered
5V 20US

Reconnect R504 if this signal is present. In order to be certain that T501 is capable of handling a load, you should unsolder L510 and R648 (not shown). These components pass the +135 volts through to T505 FBT. These components were chosen because they are easier to unsolder then more evident components, which are soldered to the board where there are eyelets. **Note: Before doing this, ensure that SW501 H Centering Switch is in the center position. Otherwise damage will occur to the set.** The signal below should be present at Q502/B.



R504 with Q502/6 unsoldered
5V 20US



HORIZONTAL DEFLECTION

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Vertical Deflection

Overview

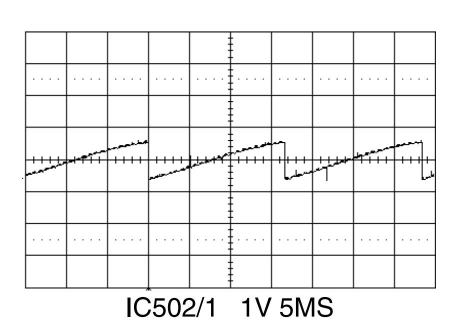
Since the Vertical Deflection circuitry has changed little in the last few years, we will not discuss its circuit description. This section of the course will be used to offer troubleshooting tips for repairing BA-5 chassis sets. If the vertical section is defective, there will be pulses missing on the I protect line to Syscon. If these pulses are missing, Syscon will shut OFF the power relay and the Standby/Timer LED will flash in sequences of four.

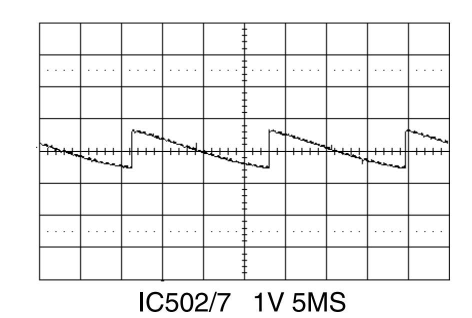
Troubleshooting

The following is a troubleshooting procedure for the vertical section if you are sure that the sequence of four flashing lights is not caused by a direct short on one of the power supply lines or a horizontal circuit malfunction. **Remember that the chirping transformer in the power supply may indicate a direct short on a power supply line or a power supply problem, and no horizontal is characterized by lack of High Voltage.**

The first step in checking the Vertical deflection circuit is to check the supply voltages at IC502/2 and IC502/4. If these voltages are missing, R549 and R550 should be checked. These resistors are .47 ohms and should always be checked with an ohmmeter because they have a tendency to change value when subjected to heat. They should never read much higher than .47 ohms with an ohmmeter.

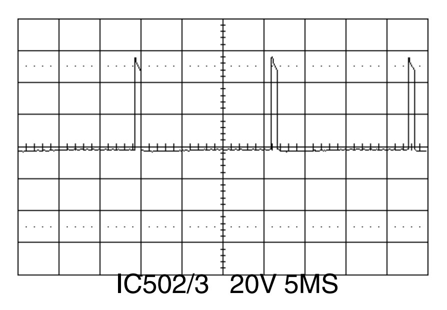
Next check the signals at IC502/1 and 7. They should look like the waveforms shown below.


IC502/1 1V 5MS


IC502/7 1V 5MS

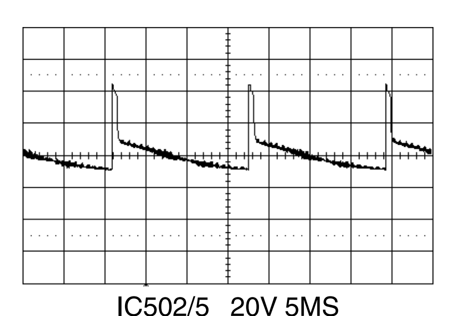
If these signals are missing, check IC1301/13 and 14. If these signals are not present, check the data and clock lines at IC1301/34 and 35. The YCJ will not output vertical drive unless communication is okay between the YCJ and the Syscon. If data or clock is missing, unload these lines from each IC individually. When a lead is lifted and the signal returns, replace that IC. If communication appears normal, replace the YCJ.

If the drive signals are present, check the signal at IC502/3. This signal should appear as shown below.


IC502/3 20V 5MS

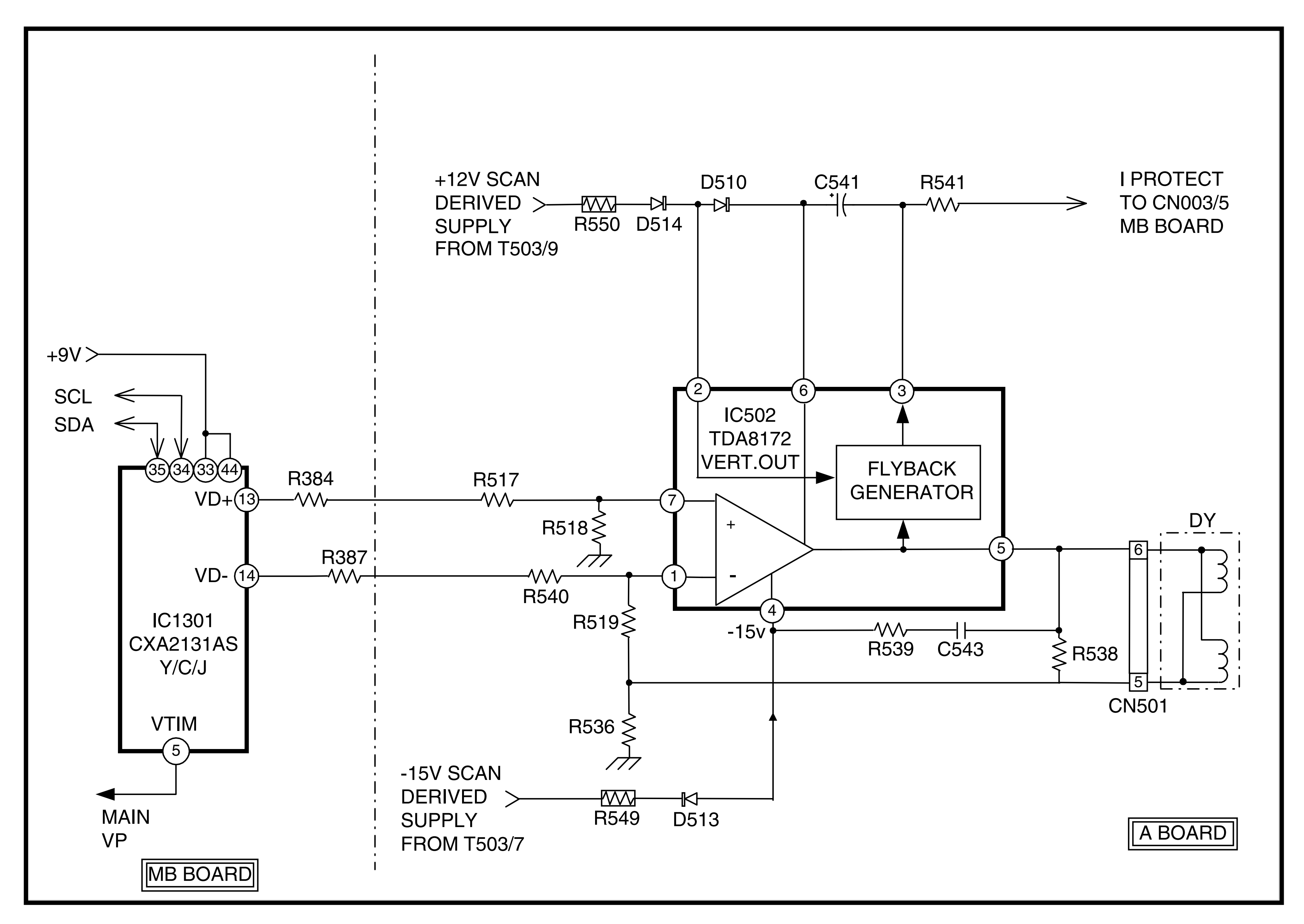
If this signal is missing, replace IC502. If the signal appears distorted or is missing the retrace portion, check or replace C541 and D510.

Check the output from IC502/5. It should look like the waveform shown below.


IC502/5 20V 5MS

If the signal at IC502/5 is missing, replace IC502. Check to be sure that the signal is getting from IC502/3 to the I protect input on the Syscon. The Syscon is located on the MA or MB board depending on the size of the set.

In the case of size or centering problems, check the values of input resistors R517, R518, R519 and R540.



VERTICAL DEFLECTION

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Video Path 24" and Under

Overview

The following section will discuss the video path for 24" and under BA-5 chassis models. These models have two sets of video inputs and a tuner input. The rear jack may also have an S Video input. These signals are routed through the video switch to the YCJ, then to the Comb Filter if necessary, back through the YCJ, and then output as RGB.

Switching

The composite video signals from the rear jack J201, the front jack J202 and the tuner are all input to IC1304 Video Switch. IC1304 has two inputs that are used to control the switching. These inputs are V0 and V1 at IC1304/2 and 4. The input to these pins comes from IC1001 Control Tuning System at pins 10 and 11. The following table shows the voltage level at these pins for different input selections:

Input	**IC1304/2 V0**	**IC1304/4 V1**
Tuner	0 Volts	0 Volts
Video 1	3.3 Volts	0 Volts
Video 2	0 Volts	3.3 Volts

Whichever input is selected will be output from IC1304/7 and then input to IC1301/41.

The separate Y and C signals from the S video jack are input directly to IC1301/2 and 4. If the input chosen is composite video, that signal will be switched through the YCJ and output at pin 6. Pin 6 is the monitor out line and would have the Y signal present at its output if an S video source were chosen. This signal will be used by IC1001 Control Tuning System for V Chip and Closed Captioning, and by IC1302 Digital Comb Filter.

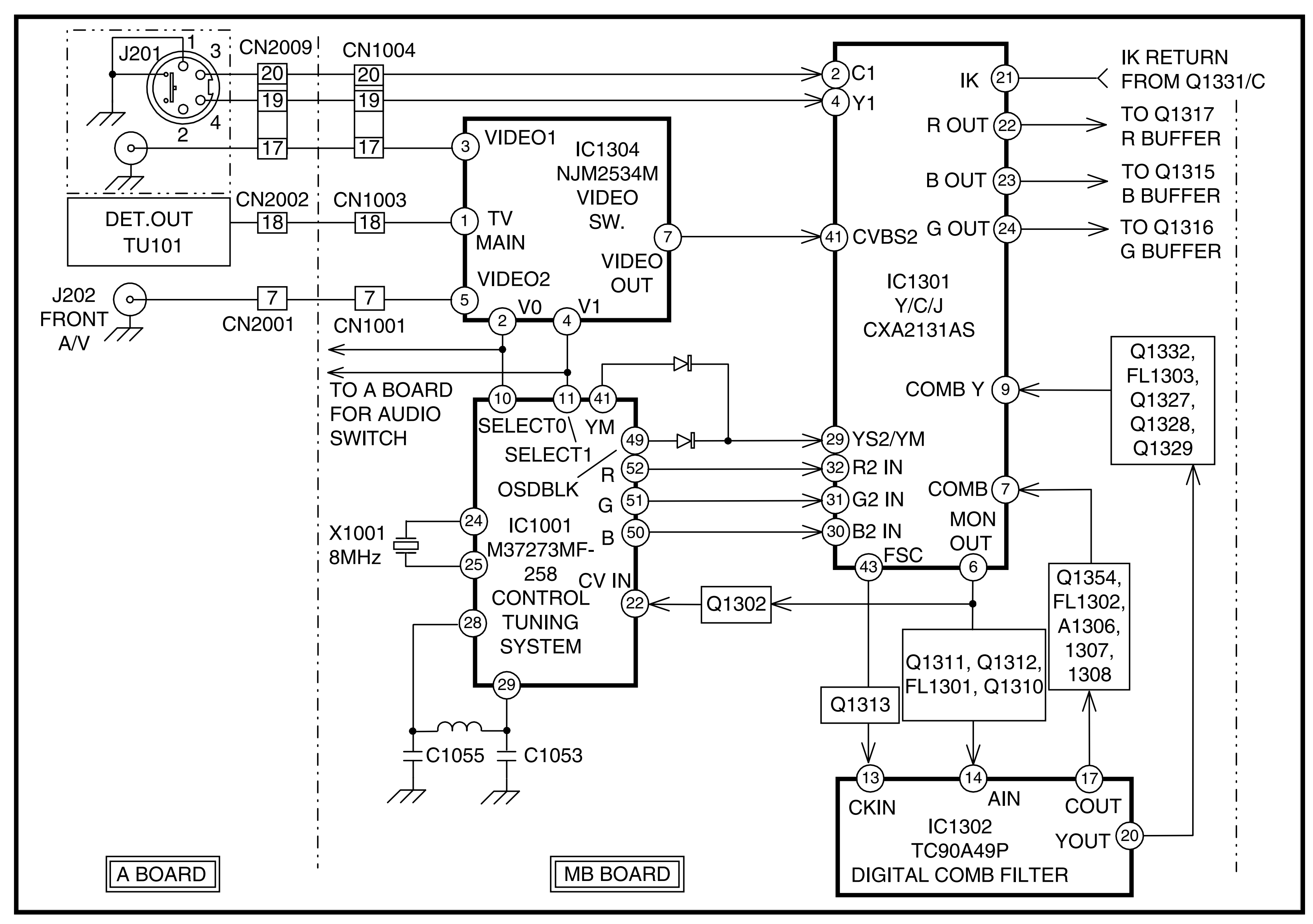
Digital Comb Filter

The Digital Comb Filter is used when composite video inputs are used. The composite video signal output at IC1301/6 is buffered and filtered by Q1311, Q1312, FL1301 and Q1310. You should note that the chroma signal has a very low amplitude at FL1303. The signal is then input to IC1302/14 A In. There is also a 3.58 MHz clock signal output at IC1301/43 FSC and input to IC1302/13. This signal is used by IC1302 Digital Comb Filter for timing. The Digital Comb Filter has separate Y and C outputs at pins 20 and 17, respectively. These signals are both buffered and filtered before being re-input to IC1301 at pins 9 and 7.

Y/C Processing

The YCJ selects which Y and C signal to use for processing. If S video is selected then the inputs at pins 2 and 4 are used. If composite video is selected, the inputs at pin 7 and 9 are chosen. Whichever input is chosen, the Y and C signals will be used to create the RGB outputs of IC1301. These signals will eventually be sent to the tube cathodes.

The YCJ also contains an input for IK to control AKB. The YCJ samples this signal and determines if each color's cathode is drawing adequate current. If the YCJ determines that there is a problem with the IK loop, video will be blanked. IC1301 YCJ communicates this to IC1001 Control Tuning System through the I²C bus. This IC will then flash the Standby/Timer LED in sequences of five to indicate an IK problem.



VIDEO PATH 24" AND UNDER

6CTV27 1223 4/24/00

RGB Drive

Overview

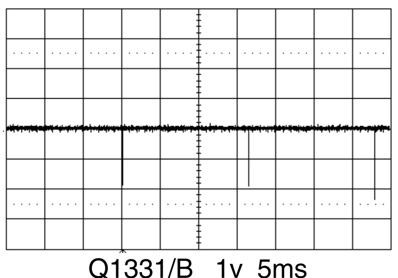
This section describes how the RGB signals are displayed by the picture tube. In addition, we will discuss the IK/AKB circuit and how it functions in the BA-5 chassis. Troubleshooting no video problems by using the IK pulses output by the YCJ will also be covered.

IK Pulses and Video Blanking

When the set is turned ON and communication is established between the YCJ and Syscon, IK pulses are output for each color. These pulses are one horizontal line in duration and they occur during every field. They are output so they occur on consecutive lines with red first, followed by green and blue. They are buffered by Q1315, Q1316 and Q1317, and applied to CN1303.

CN1303 is connected to CN705 on the CB board. The cable connecting the two boards is hardwired and cannot be unplugged from either end. The RGB signals that are applied to the CB board are input directly into pins 1, 2 and 3 of IC702 CRT Drive. IC702 amplifies and inverts these signals, and applies them to the cathode of the tube for their respective colors. If the tube is biased correctly, three lines will be produced in the overscan area of the picture tube.

IC702/5 IK outputs a voltage signal that represents the amount of total current being drawn by the tube cathodes. Since each color is outputting a pulse for one H line, in every field we would see a waveform like that shown below at Q1350 or Q1331 Base. It is very hard to see this waveform at other places so it is recommended that you only check IK return here.



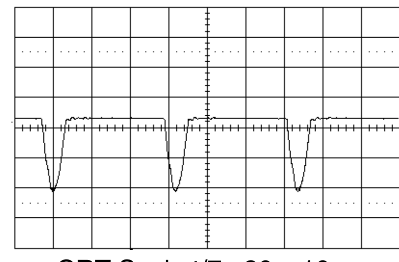
Q1331/B 1v 5ms

Place your scope in delayed mode and highlight the area that appears to be one pulse. Expand it and you will see that there are three distinct pulses, one for each color. Your scope should be set to 5ms per division. Some scopes that have less than 100MHz bandwidth may have trouble triggering on these signals.

Once the IK detect circuit in the YCJ detects that the proper current is flowing to each cathode, the video is unblanked and a picture may be seen. The YCJ continues to monitor the IK IN line for the proper signal levels. If there is a failure during operation, the Standby/Timer LED will flash in sequences of five.

Tube Bias

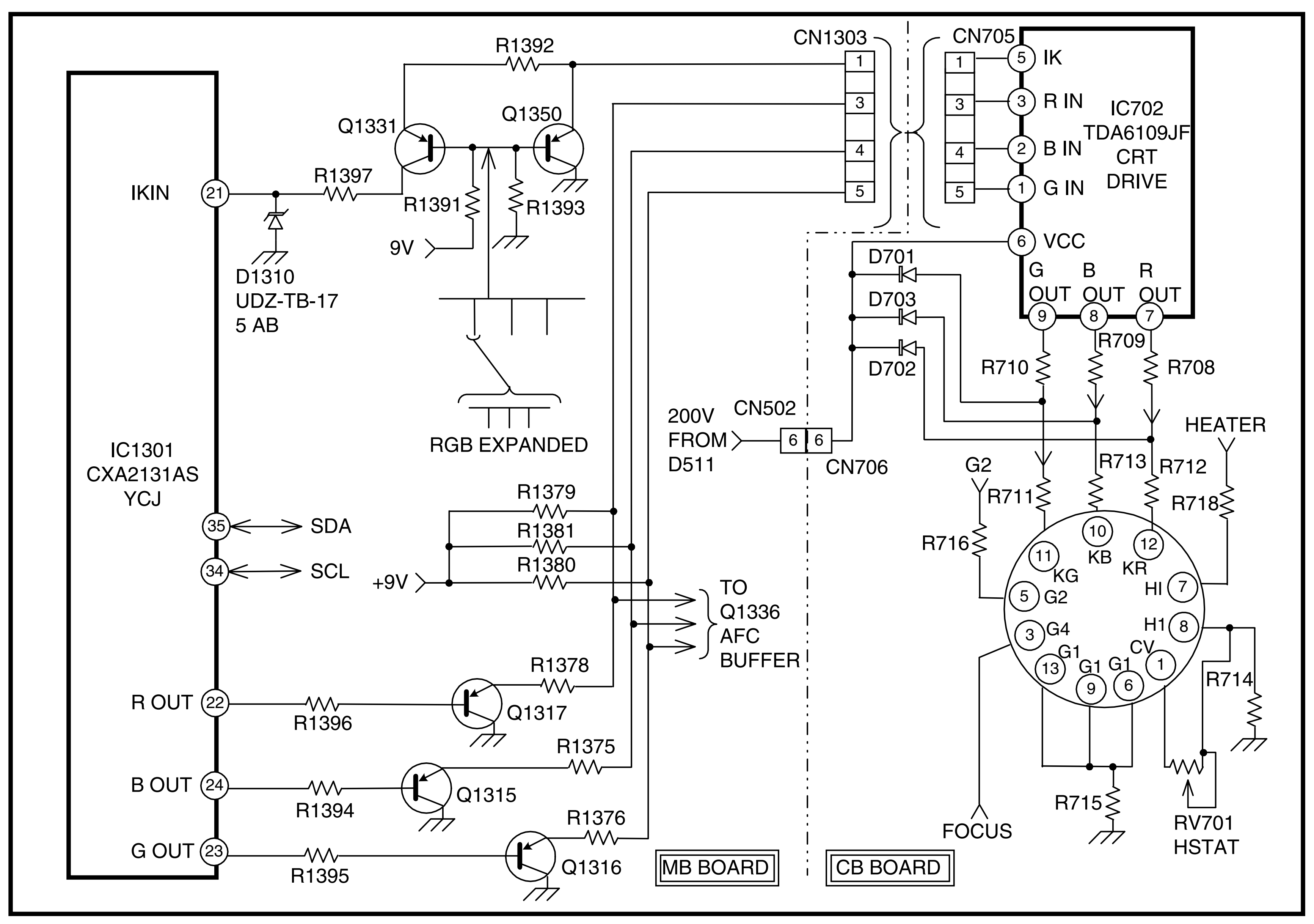
The CRT requires high voltage and other biasing voltages to properly display a picture. First it requires a heater voltage, which is developed by the FBT (not shown) on the A board. The heater is necessary to heat the cathode so that it can emit electrons. If it is missing, the cathode will not emit electrons and consequently there would be no picture. The waveform below shows the signal at CRT pin 7 H1.



CRT Socket/7 20v 10us

The G1 input on the tube is a control grid. There are three separate pins on the tube for G1. They are pins 6, 9 and 13. These pins are connected together and tied to ground through R715. There is approximately -.01 volts present at these pins when no video is input.

G2 is also a control grid and is used to limit the acceleration of electrons as they travel through the neck of the tube. These changes in the acceleration of the beam change the picture brightness. G2 measures about 316 volts on a 20” inch sample. This voltage will increase as screen size increases. G2 is set by inputting a gray scale pattern and adjusting the G2 VR on the FBT (not shown) so that the darkest bar is completely black. This is done with Contrast set to max and Brightness set to the midpoint.



RGB DRIVE

11CTV27 4/25/00

There is an input for the focus grid at pin 3 G4 of the tube. This input is from the electrical focus control VR on the FBT. It should be set for optimum focus using a dot pattern.

Pin 1 of the tube CV is used for convergence. A part of the H1 voltage is input to pin 1 through RV701. The convergence plates in the tube align the colors to each other using this voltage.

If any of these signals are incorrect or missing, the video may never unblank at turn ON. This would leave us with a starting point to troubleshoot blanking problems. Blanking can be caused by faulty IK or tube bias operation.

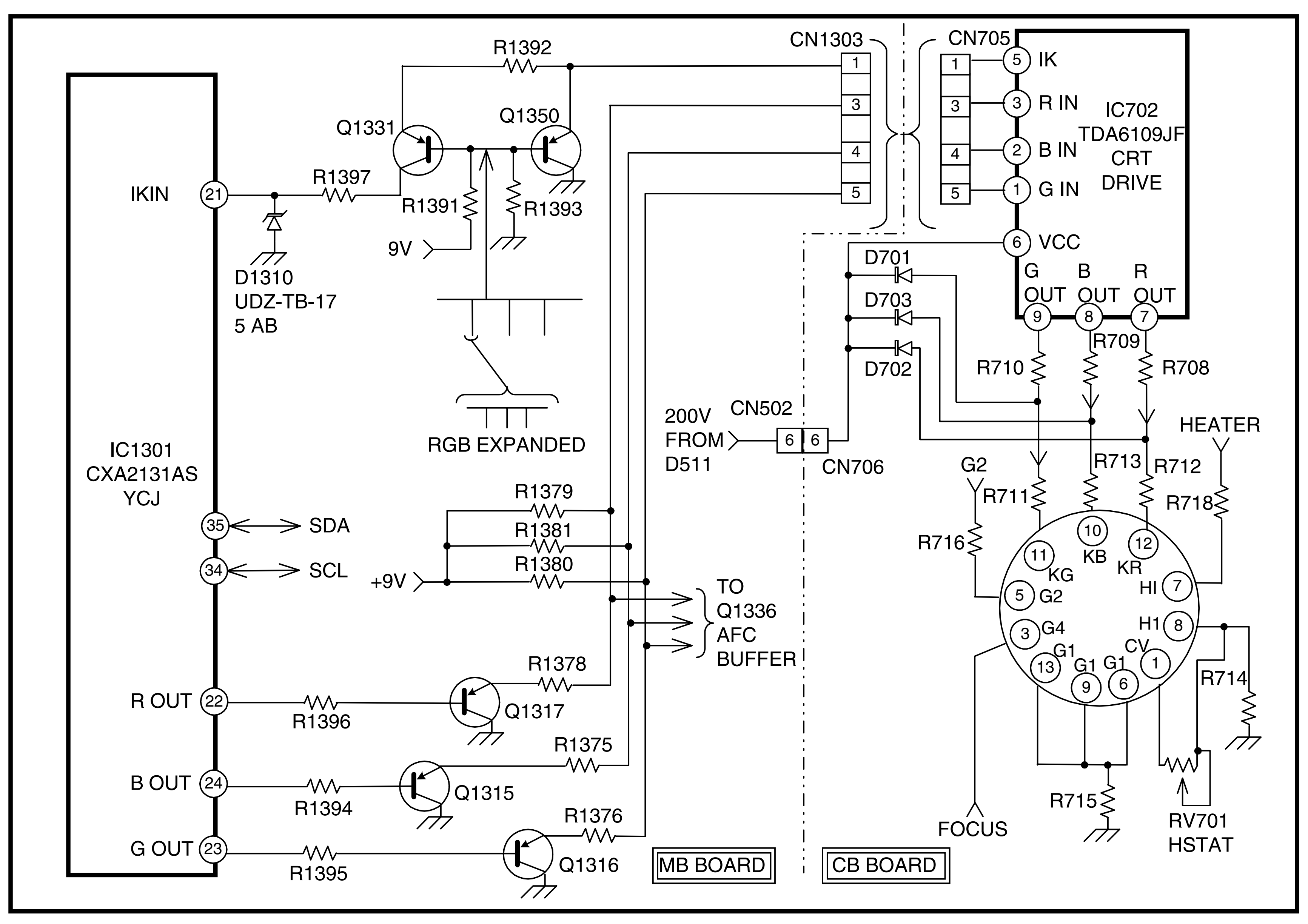
Troubleshooting

The first step in troubleshooting is to determine if there is a tube bias problem or an IK blanking problem. Use of the Self-Diagnostic feature does not seem to be of any help here. You will know if you are in video blanking if the Standby/Timer LED flashes continuously or in sequences of five soon after turn ON. **There should also be HV and sound present.** If no HV is present, the Standby/Timer LED should be flashing in sequences of two or four.

If a problem occurs with one of the colors, the set will remain in video blanking mode. This means no video or OSD will be displayed. However, the YCJ will continue to output these IK pulses. One possible method for seeing these lines uses the Service Mode. You can enter Service Mode by pressing “Display”, “5”, “Vol+”, then “Power”. After the set is ON, press the “1” button 15 times. This will bring you to the VSIZ adjustment although it will not be indicated on the display. Press the “6” button until the IK lines are visible. If one of the colors is missing, troubleshoot the path for that color. If all the colors are missing, you may have a faulty YCJ or tube bias. **Note: This method is only valid for BA-5 chassis.**

See if the YCJ is outputting a pulse for each color. If there is communication between the YCJ and Syscon, these pulses should be output. Their amplitude should be between 1 and 4 volts peak to peak. If one of these pulses is missing at the RGB outputs of the YCJ, replace it. These same pulses should also be present at the RGB inputs of IC702 on the CB board.

If the inputs to IC702 CRT Drive are good there should be an output as shown below. Note it is inverted and much larger.



RGB DRIVE

11CTV27 4/25/00

Video Path 27" and above

Overview

The video path for the 27" inch and above models is very different from the 24" inch and under models. The larger screen size models use the MA board in place of the MB board. This allows for more inputs, including component video and a 2nd tuner for PIP. There are also connections for the additional boards used for PIP and 3D Comb Filter.

Inputs and Monitor Out

Larger BA-5 chassis sets can have up to six inputs. Video 1 and 2 inputs can be composite and S Video. Video 3 input can be composite only. Video 4 is component only. There are also inputs for two tuners. One main is located on the A board and one sub is located on the MA board.

The signals are input by the jacks if it is a Video input and from the tuners if it is broadcast video. All of these signals will be output from different connectors on the A board to connectors on the MA board, with the exception of the sub tuner which is already located on the MA board. All signals are input to the YCJ.

The YCJ contains switching circuits for component, composite and S Video. The selected composite video or Y signals are output IC301/17 Mon Out. If the selected signal is a composite video signal, it is sent to Q304 and Q306 and then back to the A board for Monitor Out. It is also sent to the B Board or to IC302 Digital Comb Filter. In the case of an S Video, the Y Q304 and Q306 combine their signal with the C signal from IC301/19 with the Y from IC301/17. The output from the transistors is a composite signal that will be sent to the A board for the Monitor Out jack J204. If the component input is chosen, there will be no signal output from Monitor Out.

Comb Filter

If a composite video signal is selected and output from IC301/17, it must have the Y and C components separated. IC302 Digital Comb Filter or the B board can do this. The B board is only used on the KV27FV16 model and contains a 3D Comb Filter. Whichever comb filter is used, they will have the same effect on the signal path. They each take composite video input and output separated Y and C. These Comb Y and Comb C signals are then re-input to the YCJ at pins 22 and 20 respectively.

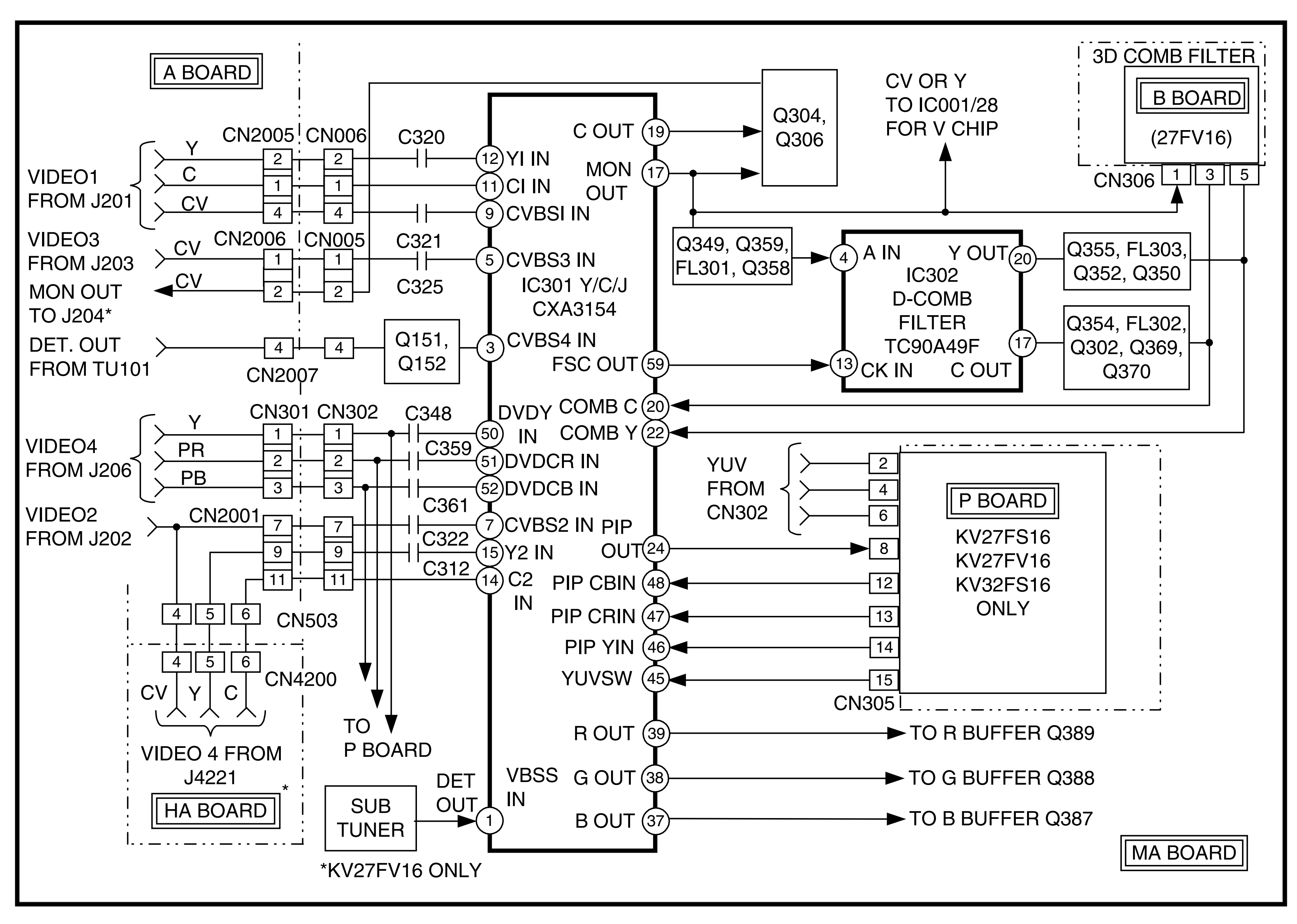
Y/C Processing

IC301 YCJ then switches the correct Y and C input to the demodulator circuits. If the composite source is chosen then the Comb Y and Comb C at pins 22 and 20 are input to the demodulator. If one of the S video inputs is chosen then Y and C from pins 12 and 11, or pins 15 and 14 are selected.

The chosen signals are demodulated to YUV signals. Then there is another switch that switches between these signals and the YUV inputs at pins 50, 51 and 52. The chosen YUV signal is then mixed with the PIP YUV inputs. These inputs also contain a Y SW signal at IC301/45 which blanks the main picture for the proper size and position of the PIP window. This signal is then processed further, matrixed to RGB and output from IC301/37, 38 and 39.

PIP

The models that have PIP will use the P board, which plugs directly into the MA board. The P board accepts composite video from IC301/24 PIP Out. If the input chosen for PIP by the user is S Video, the YCJ combines the separate Y and C and outputs them as composite video from pin 24. The PIP board will also accept inputs from the YUV component input. When these signals are input to the P board, they are modulated to form a composite video signal. This is because the PIP IC on the P board only accepts composite video inputs. The PIP processor selects one of the composite video inputs, digitizes, demodulates and compresses it. The reduced YUV signal is output from CN305/12, 12 and 14, along with the Y SW signal output from CN305/15. These YUV signals will be placed into the main video YUV signals using the Y SW input.



VIDEO PATH 27" AND ABOVE

10CTV27 1229 4/24/00

Audio without K Board

Overview

The BA-5 chassis can contain one of two types of audio circuits depending on the model. One type uses the K board and the other does not. Screen size is not a factor in the use of a K board. This section discusses models that do not use the K board.

There are also two different audio amplifiers that can be used by the BA-5 chassis. The one shown here is used in all models that output 5Wx2 or less. The other audio output, which will be shown in the Audio With K Board section, is used for models with at least 10Wx2 power output.

Switching

Models without the K board use separate audio switches, IC405 and IC406, for each channel. The left channel is switched by IC405 and the right channel is switched by IC406. These switches each have three audio inputs and two-control line inputs. The control lines are the same ones used in video switching on 24" and under models. The following table shows the state of the control lines for the input selected:

Input	IC405/406 S1	IC405/406 S2
Tuner	0 Volts	0 Volts
Video 1	3.3 Volts	0 Volts
Video 2	0 Volts	3.3 Volts

Whichever input is chosen is output from its respective IC at pin 7.

Audio Amp

The output from the switching circuit is applied to a RC network on each channel. After passing through the RC network, the signals enter IC401 Audio Amp. IC401 Audio Out amplifies the input signals and outputs them as a differential pair. These + signals are routed to CN407 and then to CN408 both on the A board. This method is used because the Audio amp is in the rear and the headphone jack is in the front of the A board. The signal then passes through the headphones and back to CN407. If there are headphones plugged into the headphone jack J401, the audio will not be returned back. This may be useful for troubleshooting in the event of a bad headphone jack.

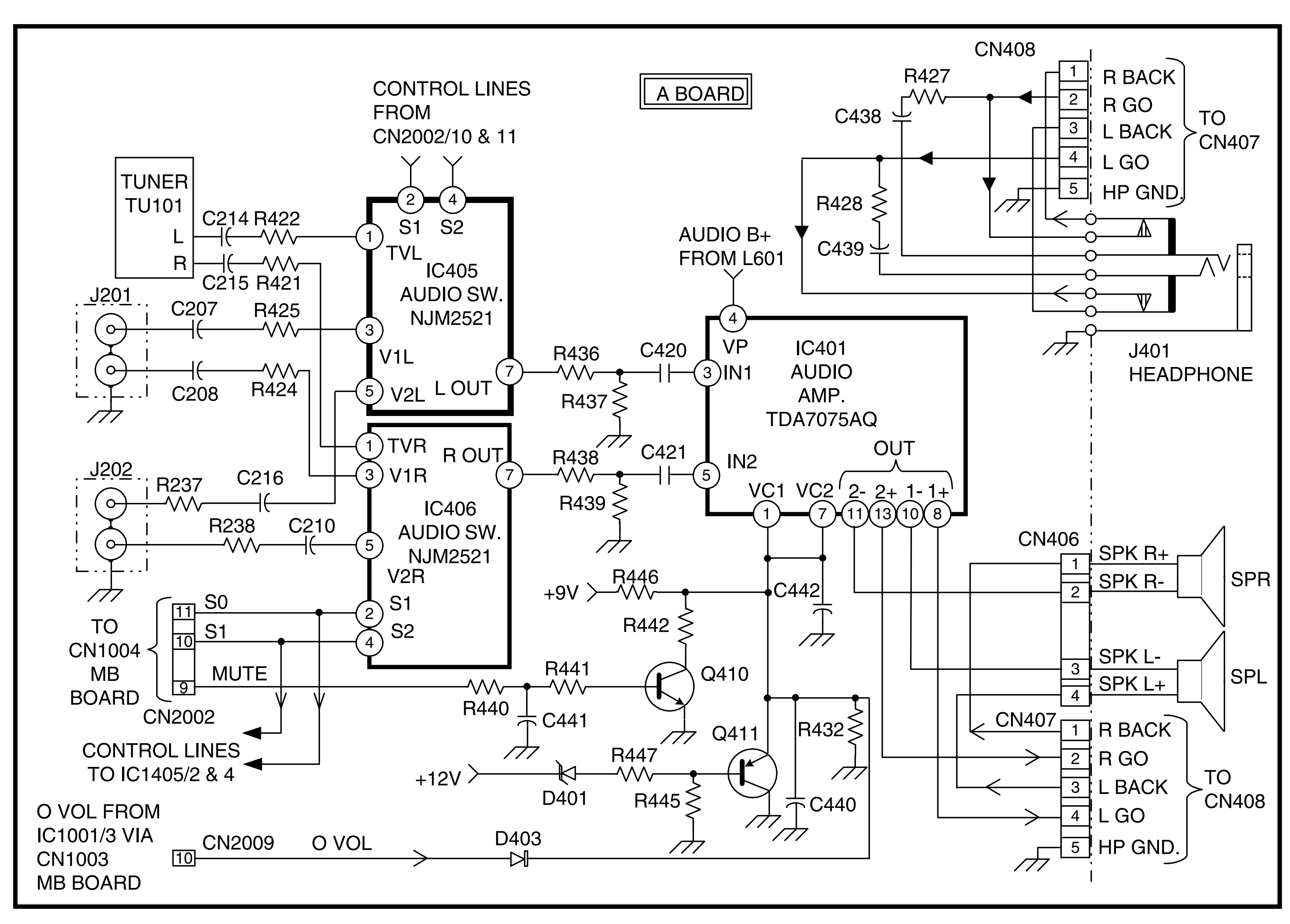
The back signal to CN407 is then applied to the R+ or L+ speaker terminal depending on which channel you are looking at. The R- and L- speaker terminals are connected to the – outputs of IC401 Audio Amp.

Volume Control and Muting

Volume control is adjusted by varying a PWM waveform output from the Syscon ICs O Vol pin. This signal is connected to CN2009/10 and applied through D403 to a filter network consisting of C440, C442 and R432. These components smooth the PWM signal to a DC voltage. This DC voltage is applied to IC401/1 VC1 and IC401/7 VC2. The DC voltage determines the level of the signal output.

The mute circuit is also connected to IC401/1 VC1 and IC401/7 VC2. When mute is called for, a HIGH signal is output from CN2002/9 Mute. This HIGH turns Q410 ON and grounds the VC1 and VC2 terminals. This reduces the audio to no volume. It should be noted here that these sets have the Auto Mute feature. If a BA-5 chassis were tuned to a weak station, the audio would be muted. When this occurs, No Signal will also be displayed on the screen.

Q411 is a Power Off Mute transistor. It is configured so that when the set is turned OFF, Q411 turns ON. This is possible because the + 9 volt line holds voltage longer than the +12 volt line. When power is disconnected and voltage remains on the 9-volt line, current flows between the B-E junction of Q411. This turns the transistor ON and grounds the VC1 and VC2 lines.



AUDIO WITHOUT K BOARD

Audio with K Board

Overview

This section discusses the second type of audio circuit that uses the K board. The K board allows for up to six different audio source inputs. It also contains ICs that perform all necessary audio processing, including volume control and SRS. SRS is not contained in all models that use the K board. We will also discuss the second type of Audio Amp.

Audio Inputs and Processing

Larger BA-5 chassis sets can have up to six audio inputs, Video 1 through 4 and inputs for two tuners. No matter what source is chosen, both channels of audio are applied to the K board via CN460 and CN450. Then both channels of all sources are applied to IC404 Audio Processor.

IC404 Audio Processor contains a switching network that will switch the selected source to the various outputs. The selection is performed via I²C commands from the Syscon. The audio selected is directly output from IC404/11 and 30 Monitor Out. This signal will be sent to J204 Monitor Out jack on the A board.

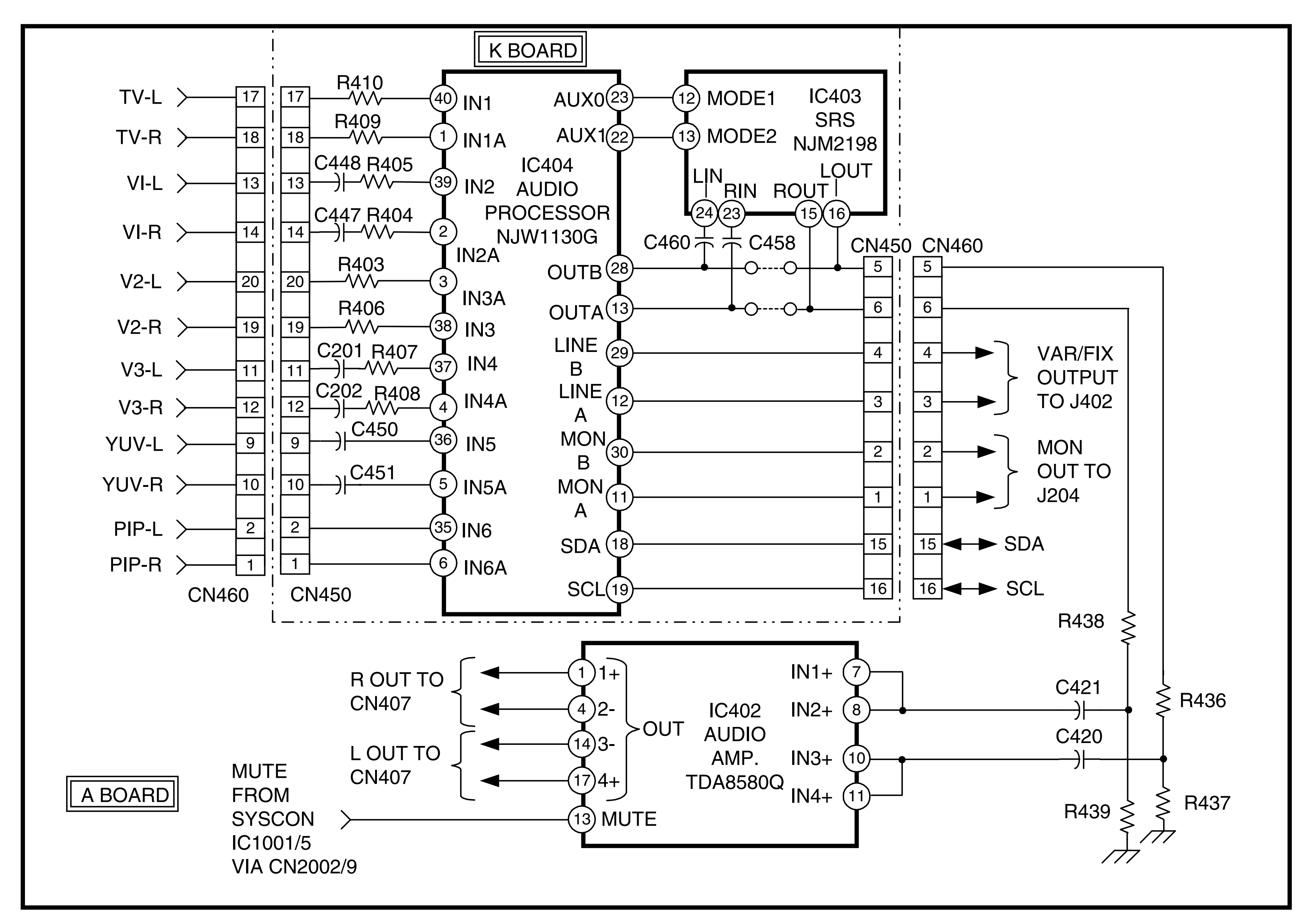
The signals will also be applied to the following internal circuits: AGC, BBE, volume, matrix surround sound, tone and another volume circuit. Data from the I²C bus will determine how much audio processing is performed. The left and right signals are output for the Var/Fix Output at J402 on the A board from IC404/ 12 and 29. The customer can select from the menu if they want this output to be fixed or variable.

The outputs from IC404/13 and 28 are the main audio outputs of the set. Depending on the model, this audio will be input to IC403 SRS or to the A board for amplification. If the model contains SRS, these signals are input at IC403/23 and 24. The audio is processed by the SRS circuit using the two control outputs from IC404/22 and 23. These control outputs are used because IC403 SRS is not I²C compatible. IC403 then outputs audio from pins 15 and 16.

Whether the unit contains the SRS IC or not, audio will eventually be applied to CN450/5 and 6. From there it will go to the A board via CN460/5 and 6.

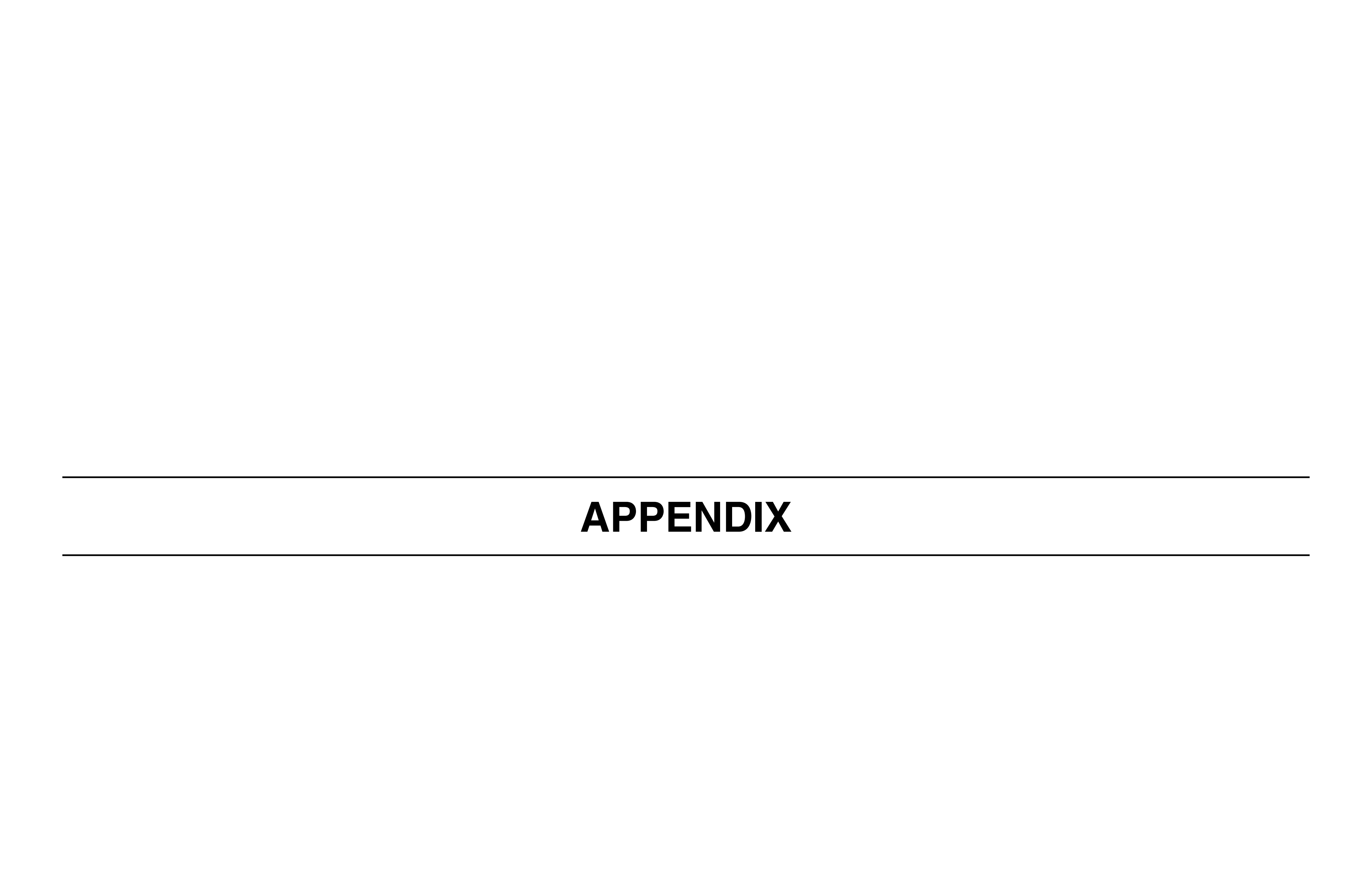
Audio Amp

Once the audio is on the A board, it is applied to the same RC network used on models without K boards. The values of the resistors in this case will determine if the set will output 10x2 watts per channel or 15x2 watts per channel. The signals are applied to IC402 using two pins for each channel. The output is differential and follows the same path as models without K boards. Some larger sets do not contain headphone jacks. If the set does not, audio is applied to the speakers from the + outputs of IC402. The – outputs of IC402 are applied to the – side of the speakers.



AUDIO WITH K BOARD

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APPENDIX

Standby Power Supply

*Note: The following is an excerpt from CTV-26, which covered the AA2W chassis. The operation of the Standby Power Supply in the BA-5 chassis is identical, but component names are different.

Overview

The standby power supply is a switching power supply used to create Standby 5V. The Standby 5V line is used to power the Tuning Micon and EEPROM and any other circuits which need power when the set is OFF.

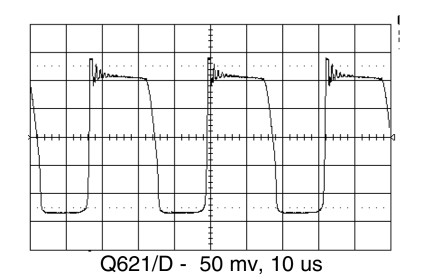
Converter Operation

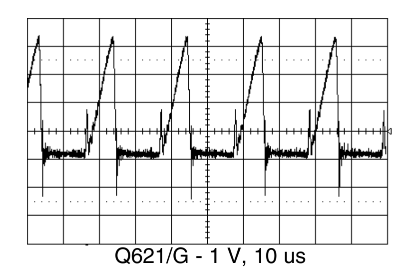
Operation of the Standby power supply begins when the set is plugged in. The AC line voltage is applied across the standby power supply. The AC low side is ground for this circuit. The AC high side is applied to a half wave rectifier consisting of D621 and D622. Two diodes are used so that there will be protection should one of them fail. This voltage is then applied to T621/1 SRT Input through R639. R639 is a fusible resistor used for current limiting and failure protection. It will open if the standby switching circuit draws excessive current. Please note that the board has T621 SBT silk-screened on it. This differs from the service manual, which calls T621 SRT.

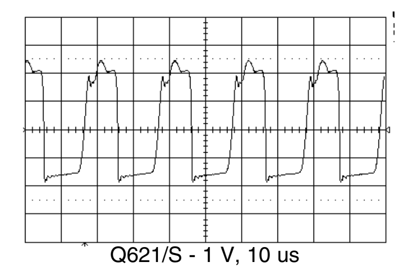
When the voltage is applied to T621/1 SRT Input, current flows through the winding and R631 to Q621/G. Q621 Converter is a FET with added protection. When a positive voltage is applied to the gate, it begins to conduct drain to source. This reduces the voltage at T621/3 to close to zero. Normally this would reduce the voltage at Q621/G, but a voltage is supplied to the gate through R632 and C630 from T621/4. This voltage is induced into the secondary winding of T621/4 when current flows through the winding between T621/1 and T621/3. The voltage is not permanent due to C630. As C630 charges, it reduces the voltage at Q621/G. Once this voltage falls below a certain threshold, Q621 Converter turns OFF.

Once Q621 Converter turns OFF, all polarities are reversed. This reversal of polarity helps speed up turn OFF of Q621. D623, along with C631 and R640, form a snubber network (voltage clamp). This network clamps excessive voltage overshoot caused by the collapsing magnetic field of T621 SRT and returns the excessive voltage to C629. When the field collapses fully, current begins to flow through T621/1 and 3.

The waveforms below show what will be seen at Q621.


Q621/D - 50 mv, 10 us

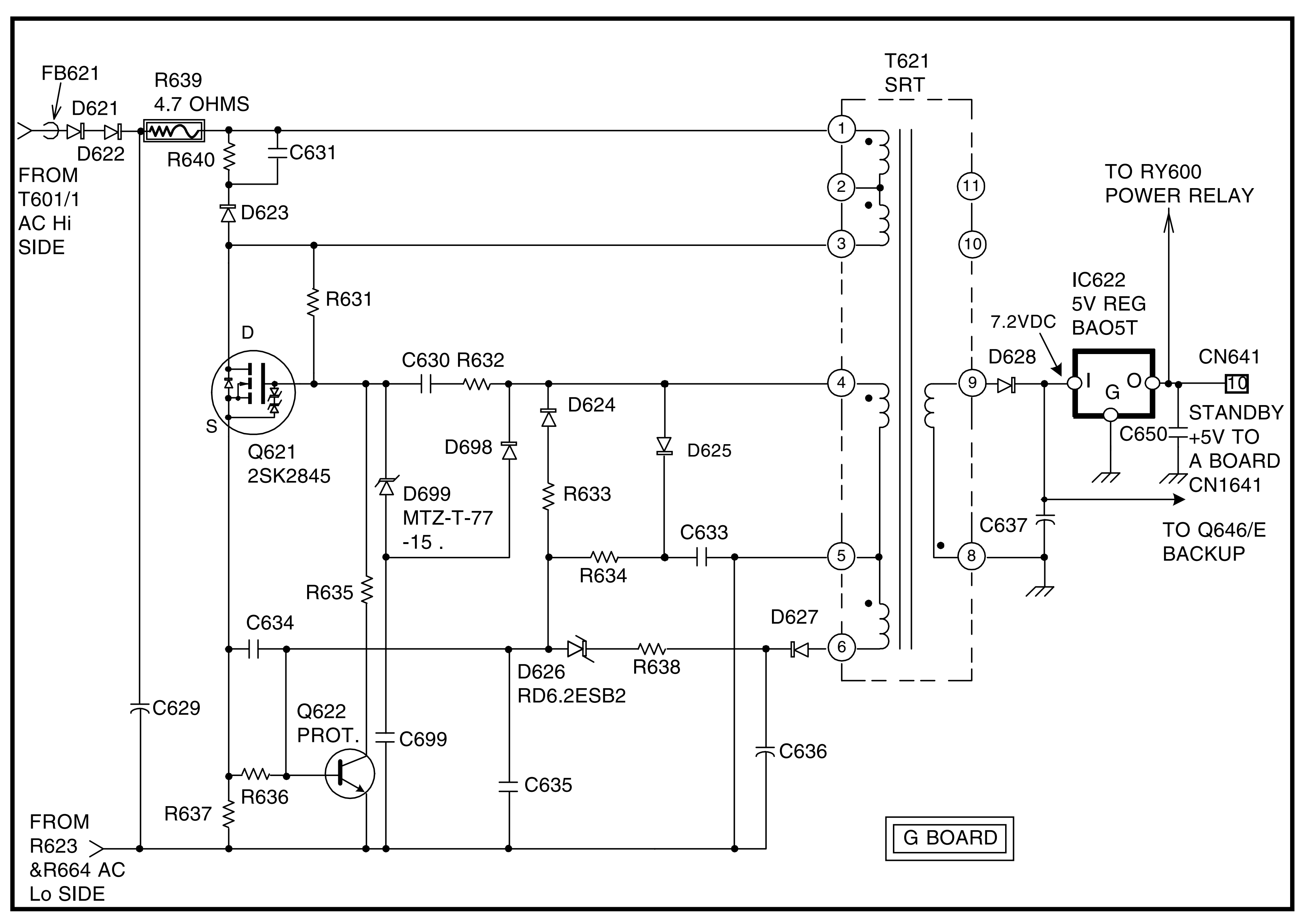

Q621/G - 1 V, 10 us


Q621/S - 1 V, 10 us

Regulation

Changing the frequency of the switching regulates the output voltage at the secondary winding comprised of T621/8 and 9. Taking a sample voltage from T621/4 and applying it to rectifiers D624 and D625 does this. As this voltage rises and falls, the rectified voltage is applied to Q622/B through R634. When Q622 begins to conduct, it lowers the voltage at Q621/G and changes the switching frequency.

The changing frequency will change the amount of voltage coupled to the secondary winding consisting of T621/8 and 9. If the load on the secondary output increases, the frequency of switching will decrease. This brings the frequency of the converter closer to the optimum operating frequency of T621 SRT. Moving closer to this optimum frequency causes more voltage to be provided at T621/9. The opposite occurs when the load on the supply decreases. This causes the frequency of operation to be increased and the amount of voltage coupled to T621/9 to be decreased. The supply typically operates at 45 kHz when the set is OFF and at about 30 kHz when the set is operating. The incoming line voltage also effects the frequency of switching operation.



STANDBY SUPPLY

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Over Current Protection (OCP)

Monitoring the voltage across R637 is used for over current protection. This voltage is representative of the amount of current flowing through Q621 Converter since it is in series with the transistor. If this voltage should rise to .6 volts, it will cause Q622 to turn ON. If Q622 were to turn ON, it would shunt Q621/G voltage to ground. This would cause Q621 Converter to stop conducting.

Over Voltage Protection (OVP)

Over voltage protection is done by rectifying the voltage at T621/6 with D627. This voltage is filtered by C636 and applied to D626 through R638. If this voltage should rise above 6.2 volts, D626 begins to conduct. When its conduction allows Q622 Protect to turn ON, over voltage protection is employed. Q622 Protect turns ON and grounds Q621/G, which stops the converter from switching.

D699 is also used for OVP. The signal from T621/4 is rectified by D698. This creates a negative voltage across C699. If this negative voltage becomes great enough, D699 conducts and the Q621/G voltage is brought lower.

Secondary Output

The power coupled through T621 SRT places a voltage on T621/9 that, when rectified and filtered by D628 and C637, is 7.2 volts. This voltage is constant due to the regulation circuit on the primary side of T621 SRT. This 7.2 volts is applied to Q646/E for backup during the start of regulation by the regular power supply.

It is also applied to IC622 5-Volt Regulator, which regulates its output to 5 volts. This 5 volts is sent to CN641/10 which connects to the A board and powers the Tuning Micon and other circuits. It is also applied to RY600 Power Relay.

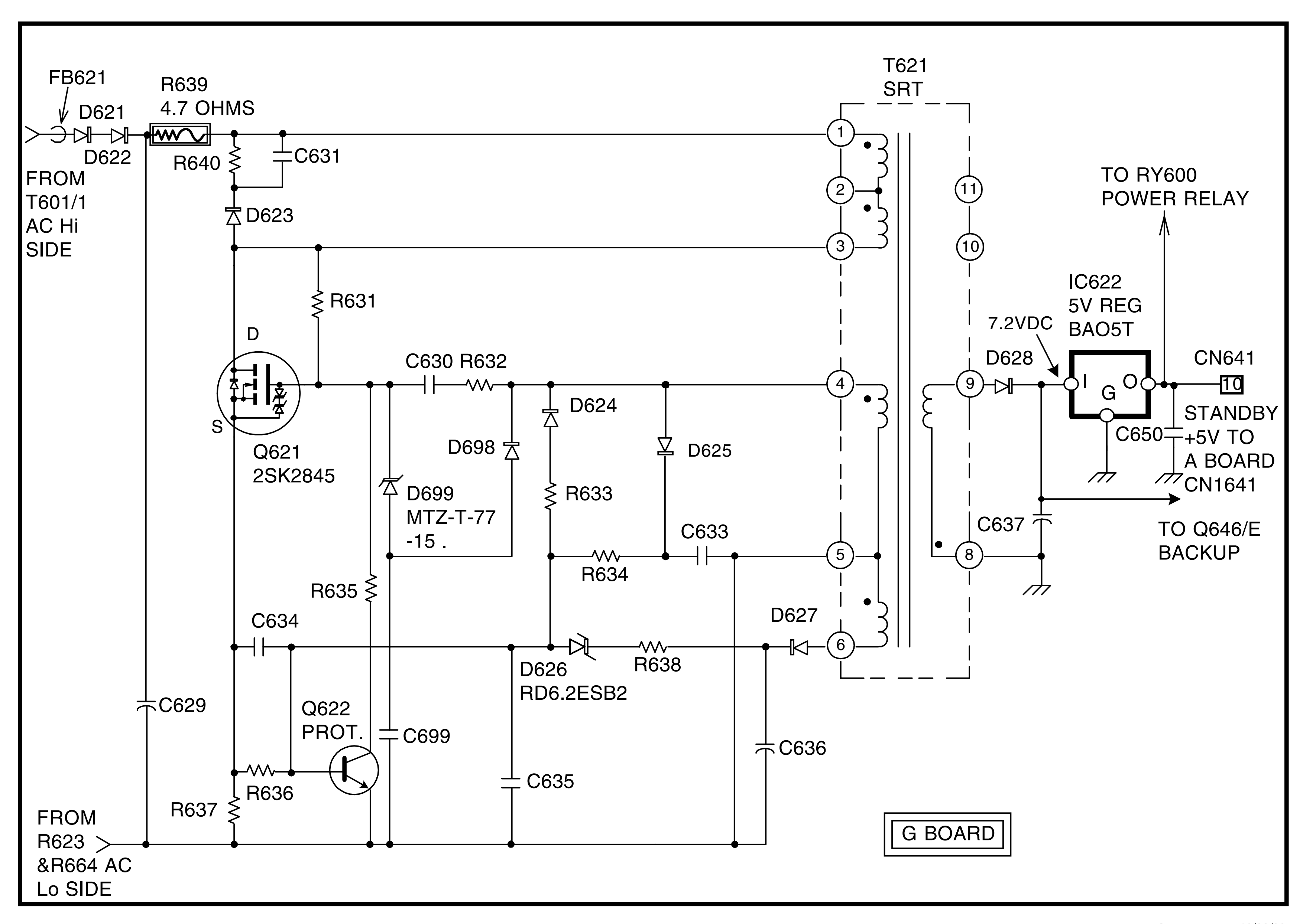
Checking Q621

Testing a MOSFET device is simple. The leads show infinite resistance to each other except for drain to source in one direction because of the presence of a protection diode.

To prove the device is functional:

1. Connect the negative lead of the ohmmeter to the SOURCE lead.
2. Touch the ohmmeter positive lead to the gate, to pre-charge it.
3. Connect the ohmmeter positive lead to the DRAIN. If the device is good you will get a resistance reading of about 400-1k ohms.

Some DVMs do not produce enough DC voltage in the ohms mode. The diode check mode can be used with these models. When using the diode mode, a low voltage drop is shown after pre-charging the gate.



STANDBY SUPPLY

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